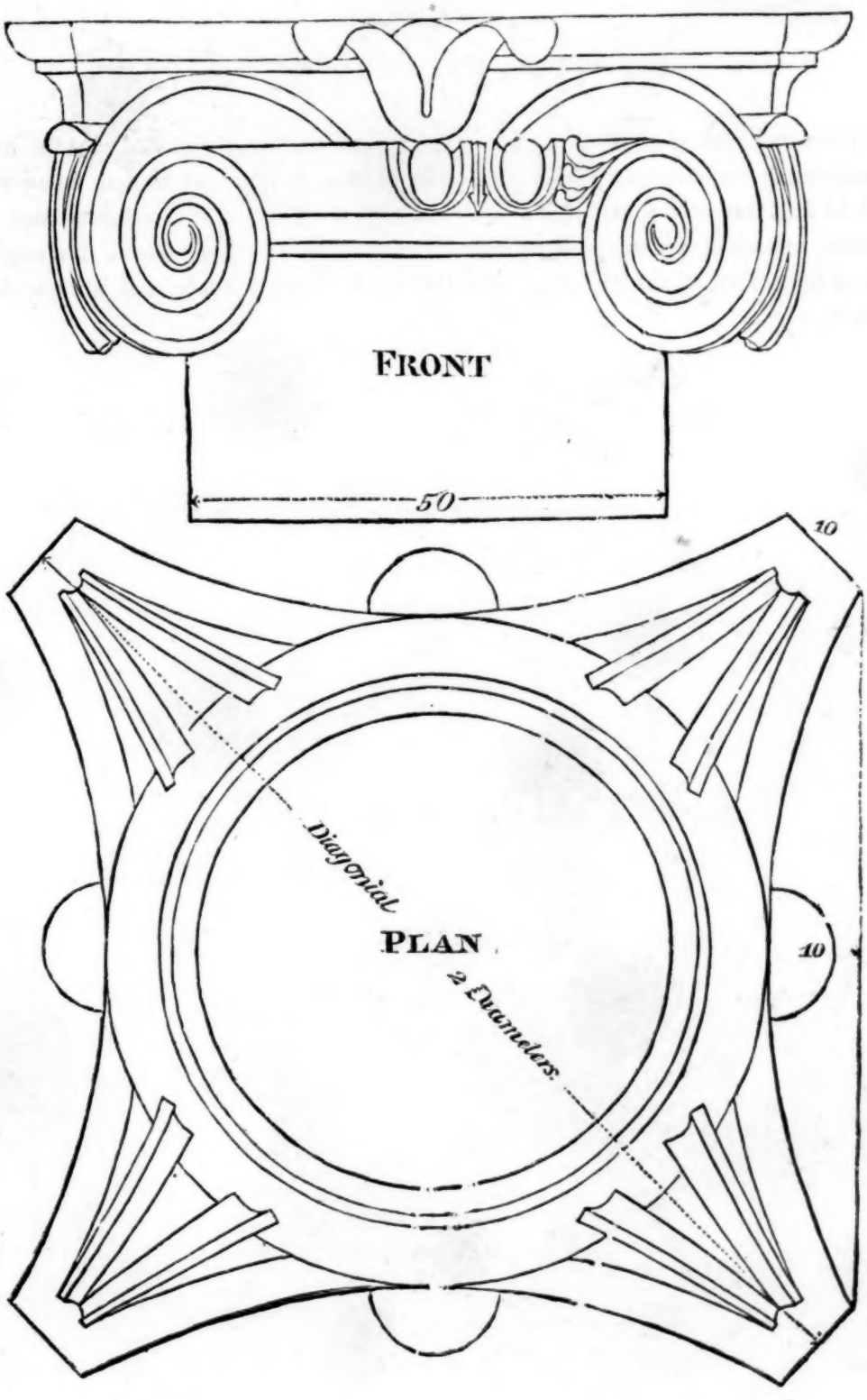
MECHANICS' MAGAZINE,

VOLUME VIII.—No. 4.] OCTOBER, 1836. [WHOLE NUMBER, 46

IONIC CAPITAL.

Plate 23.



THE STUDENTS' INSTRUCTOR

IN DRAWING AND WORKING

THE FIVE ORDERS OF ARCHITECTURE.

BY PETER NICHOLSON, ARCHITECT.

(Continued from page 74.)

PLATE XXIII.

The front and plan of the angular Ionic capital; the plan is inverted that the mouldings underneath the abacus may be seen; the volutes in front are drawn according to Plate XXIX.; this sort of capital has an advantage over the others, it fronts each of its sides alike; which is not the case with the Grecian capital, unless one of the angles is horned at the return of the building; which is unpleasing to some, and not considered as correct.

IONIC ORDER.

Plate 24.

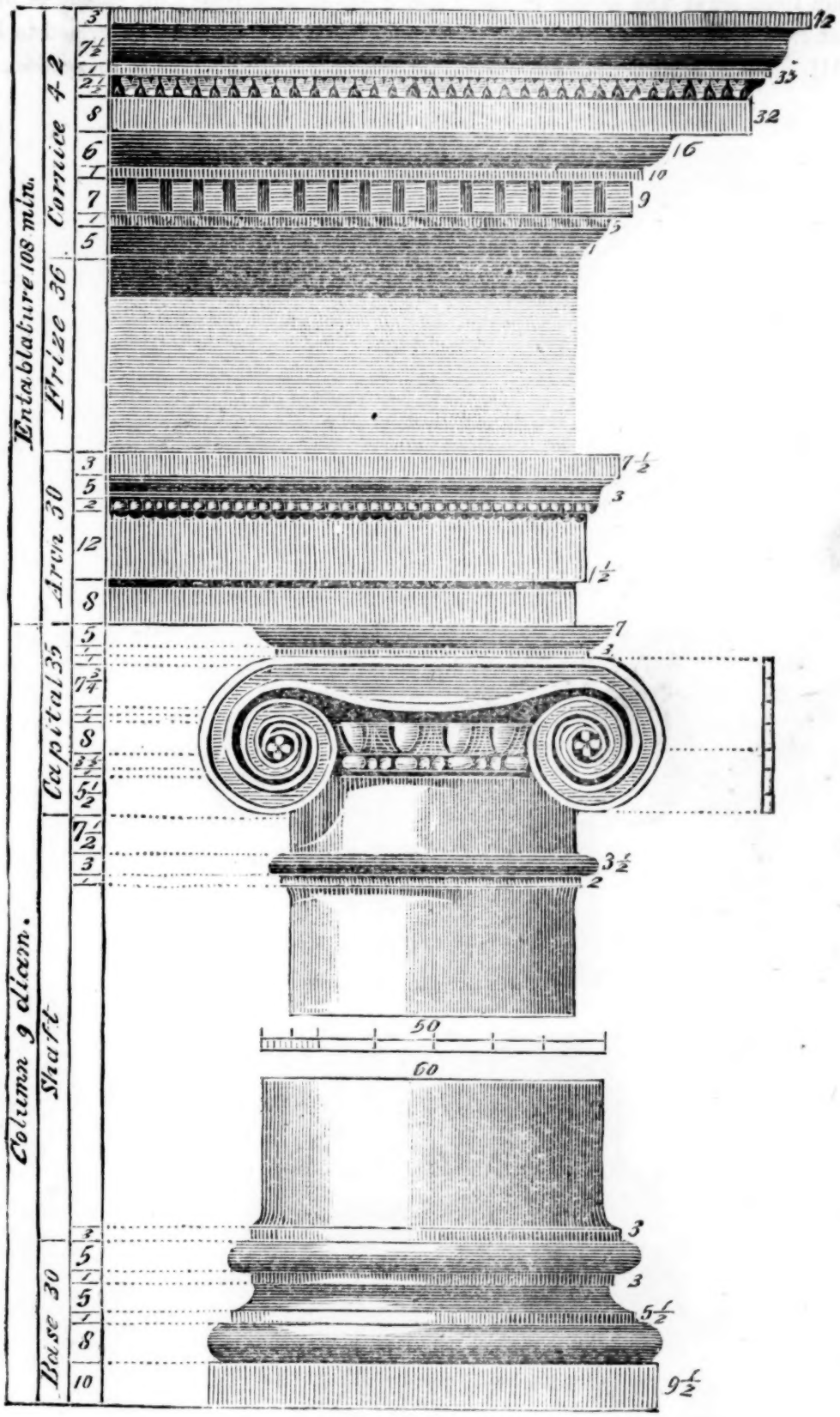


PLATE XXIV.

Is the Ionic order with dentils in the cornice on an attic base; the capital is in the Grecian taste; the manner of drawing the upper list is the same as described to Plate XXVIII. the under list is drawn by hand, the other parts are obvious to inspection.

MODERN IONIC.

Plate 25.

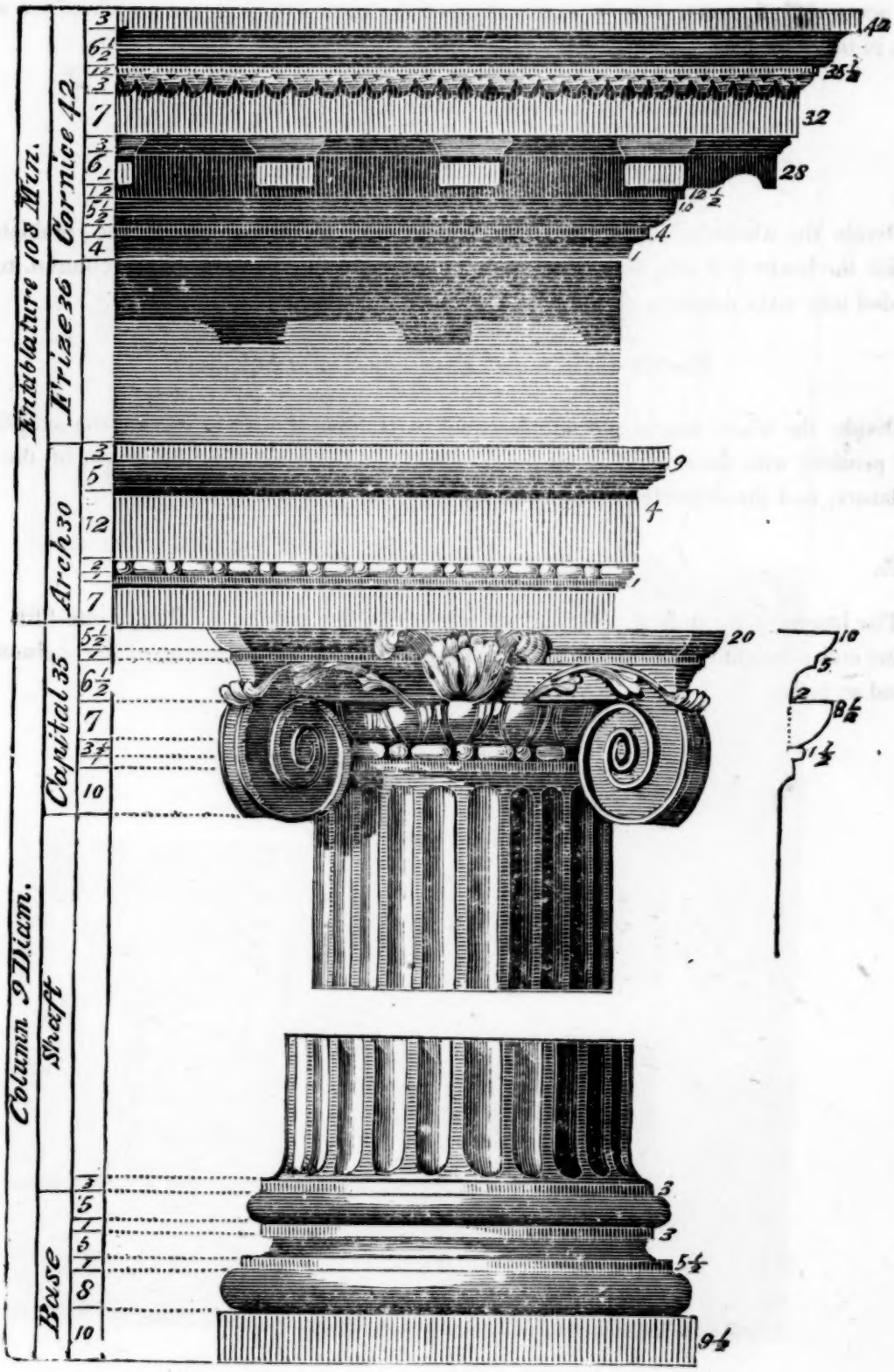


PLATE XXV.

The Ionic order with modillions, and an angular capital; the measures of the parts are accurately figured; Fig, 1. is a section of the capital through the middle of the abacus, in order to show the projection of the mouldings.

TO DRAW THE IONIC ORDER TO A GIVEN HEIGHT.

For the Column and Entablature.

Divide the whole height into six equal parts, give the upper one to the entablature, divide the lower five into nine parts, and one will give the diameter of the column, to be divided into sixty minutes, as a scale to work or draw by.

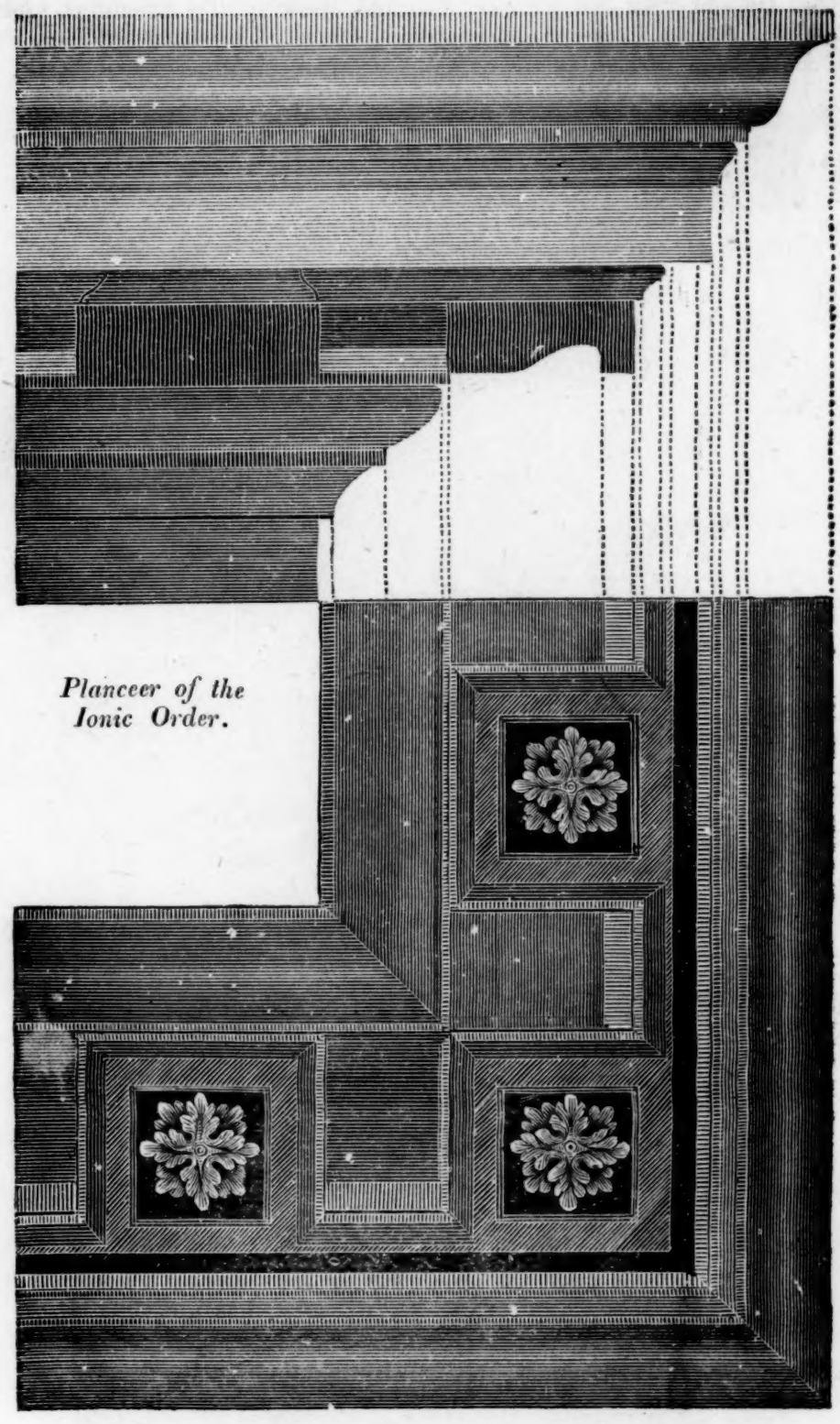
For the Column and Entablature on a Subplinth.

Divide the whole height into twelve equal parts, give the lower one to the subplinth, and proceed with the remaining eleven as above, and you will get the height of the entablature, and the diameter of the column.

For the Column, Entablature, and Pedestal.

The height of the pedestal, for this or any of the five orders, is always one-fifth part of the entire height; then the height of the entablature, and diameter of the column, is found as before.

Plate 26.



Planceer of the Ionic Order.

PLATE XXVI.

The Ionic cornice with the planceer inverted, showing the finishings underneath the cornice.

IONIC—TEMPLE AT ATHENS.

Plate 27.

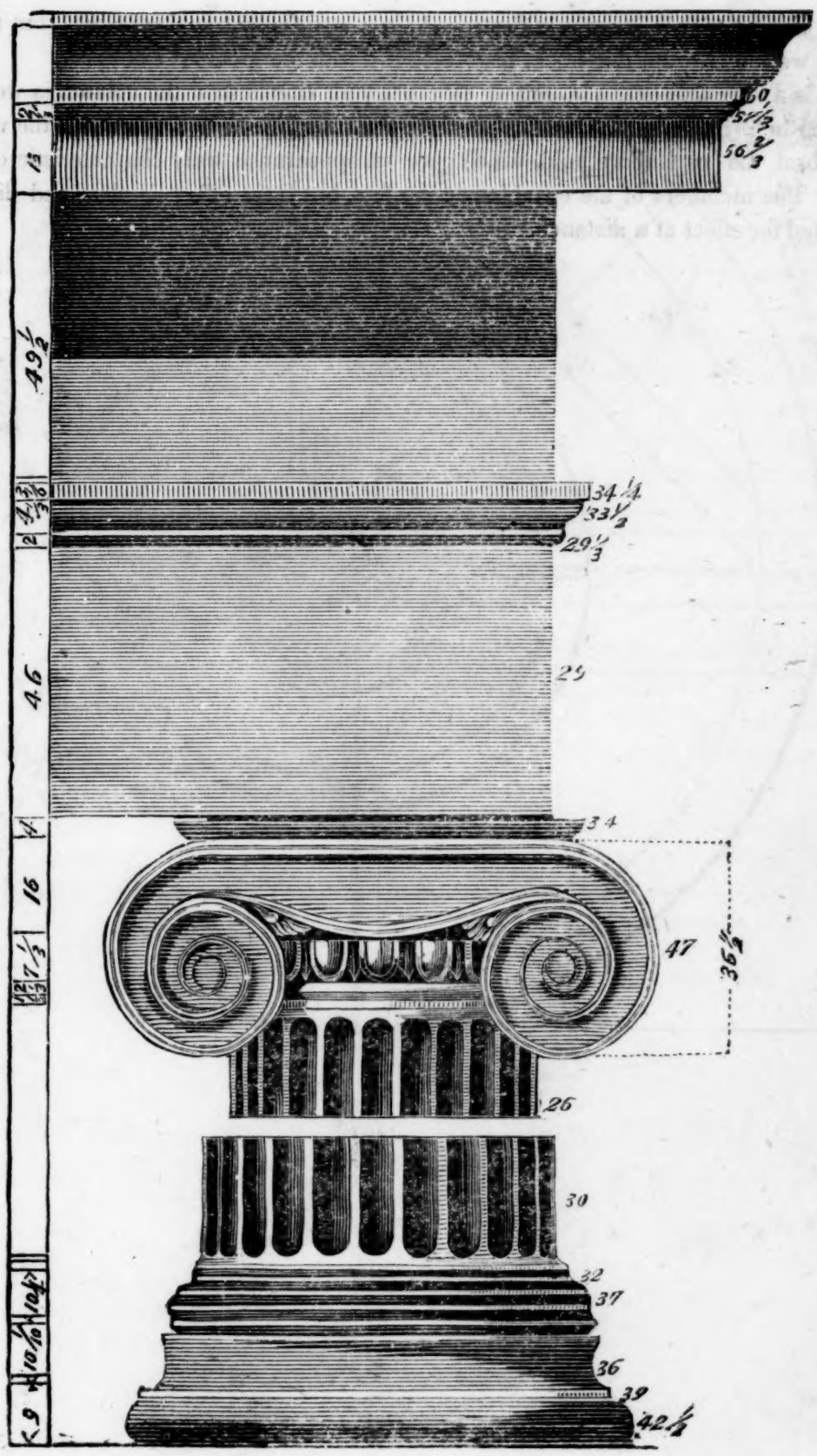


PLATE XXVII.

FROM THE IONIC TEMPLE ON THE ILISSUS, AT ATHENS.

This elegant temple is entirely destroyed; not a fragment now remains: but the ingenious workman, from this book, may restore it with the greatest exactness.

This is a very fine example, uniting elegance with simplicity: the column is well proportioned in all its parts; the turnings of the spirals are gracefully formed, and the volutes which form the capital are bold, which give an appearance truly characteristic of this order. The members of the enaablature are few, but their effect is clear and distinct, calculated for effect at a distance.

IONIC VOLUTE.

Plate 28.

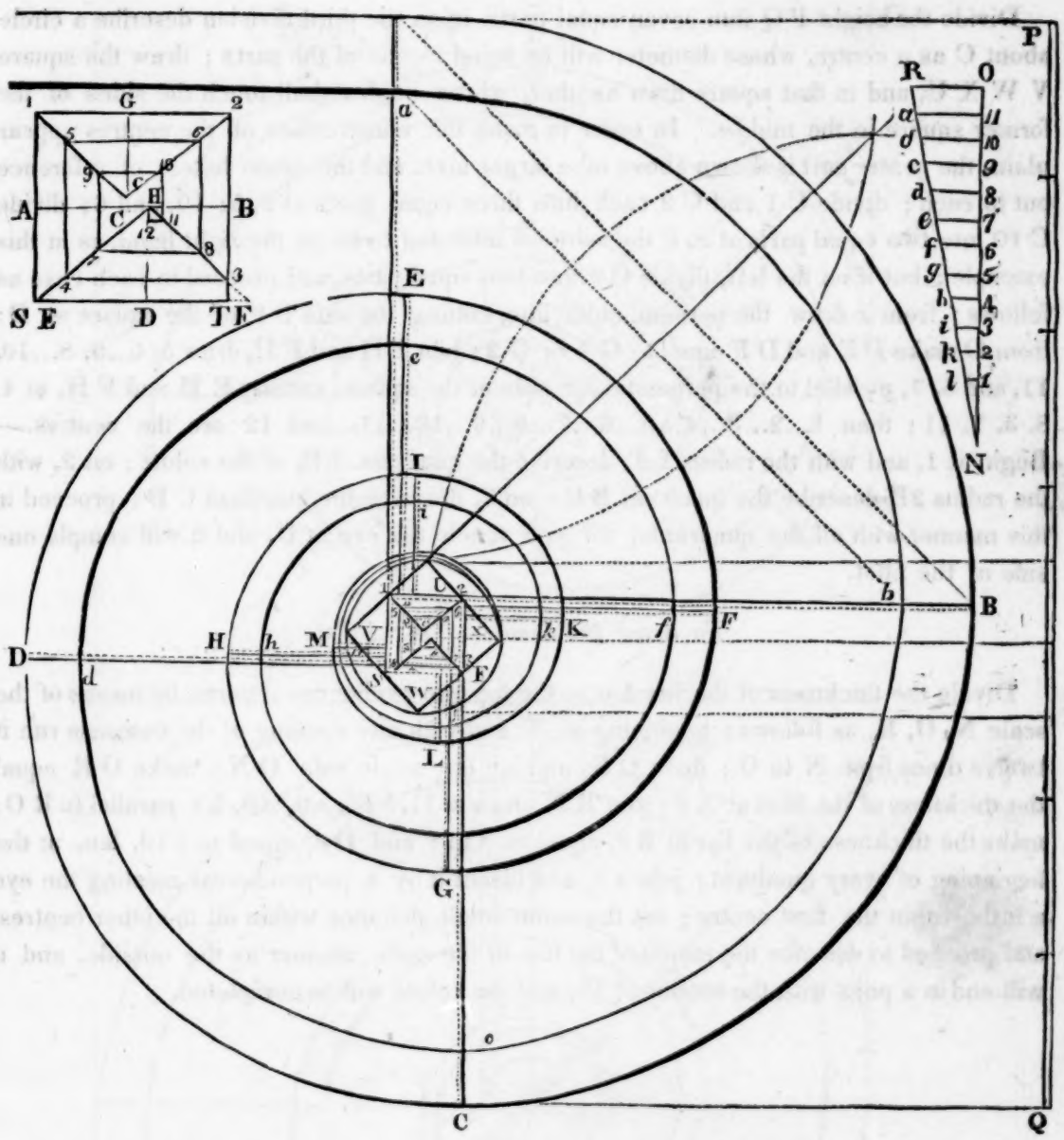


PLATE XXVIII.

TO DESCRIBE THE IONIC VOLUTE.

Divide the height P Q into seven equal parts, upon the third division describe a circle about C as a centre, whose diameter will be equal to one of the parts; draw the square V W X U, and in that square draw another, whose angles shall touch the sides of the former square in the middle. In order to make the construction of the centres appear plain, the centre part is shown above of a larger size, and the same letters of reference put to each; divide C 1 and C 2 each into three equal parts at 9, 5; 10, and 6; divide C 10 into two equal parts at *x*, if the volute is intended to be on the right hand, as in this example; but if on the left, divide C 9 into two equal parts, and proceed in each case as follows: from *x* draw the perpendicular line, cutting the side S F of the square at D; from D make D E and D F equal to G 1 or G 2; join E H and F H, draw 5, 4...9, 8...10, 11, and 6, 7, parallel to the perpendicular side of the square, cutting E H and F H, at 4. 8. 3. 7. 11; then 1...2...3...4...5...6...7...8...9...10...11...and 12 are the centres.—Begin at 1, and with the radius 1 A, describe the quadrant A B, of the volute; on 2, with the radius 2B describe the quadrant B C: on 3, describe the quadrant C D; proceed in this manner with all the quadrants, till you touch the eye at U, and it will comple one side of the fillet.

To draw the inside of the Fillet.

Divide the thickness of the list A *a* at the top into twelve equal parts, by means of the scale N, O, R, as follows; beginning at N, and with any opening of the compass run it twelve times from N to O; draw O R, making any angle with O N; make O R equal the thickness of the fillet at A *a*; join R N, draw *a* 11, *b* 10, *c* 9, *d* 8, &c. parallel to R O; make the thickness of the list at B *b*, equal to *a* 11; and D *d*, equal to *b* 10, &c. at the beginning of every quadrant; join *a b*, and bisect it by a perpendicular meeting the eye a little within the first centre; set the same small distance within all the other centres, and proceed to describe the inside of the list, in the same manner as the outside, and it will end in a point with the outside at U; and the volute will be completed.

Plate 29.

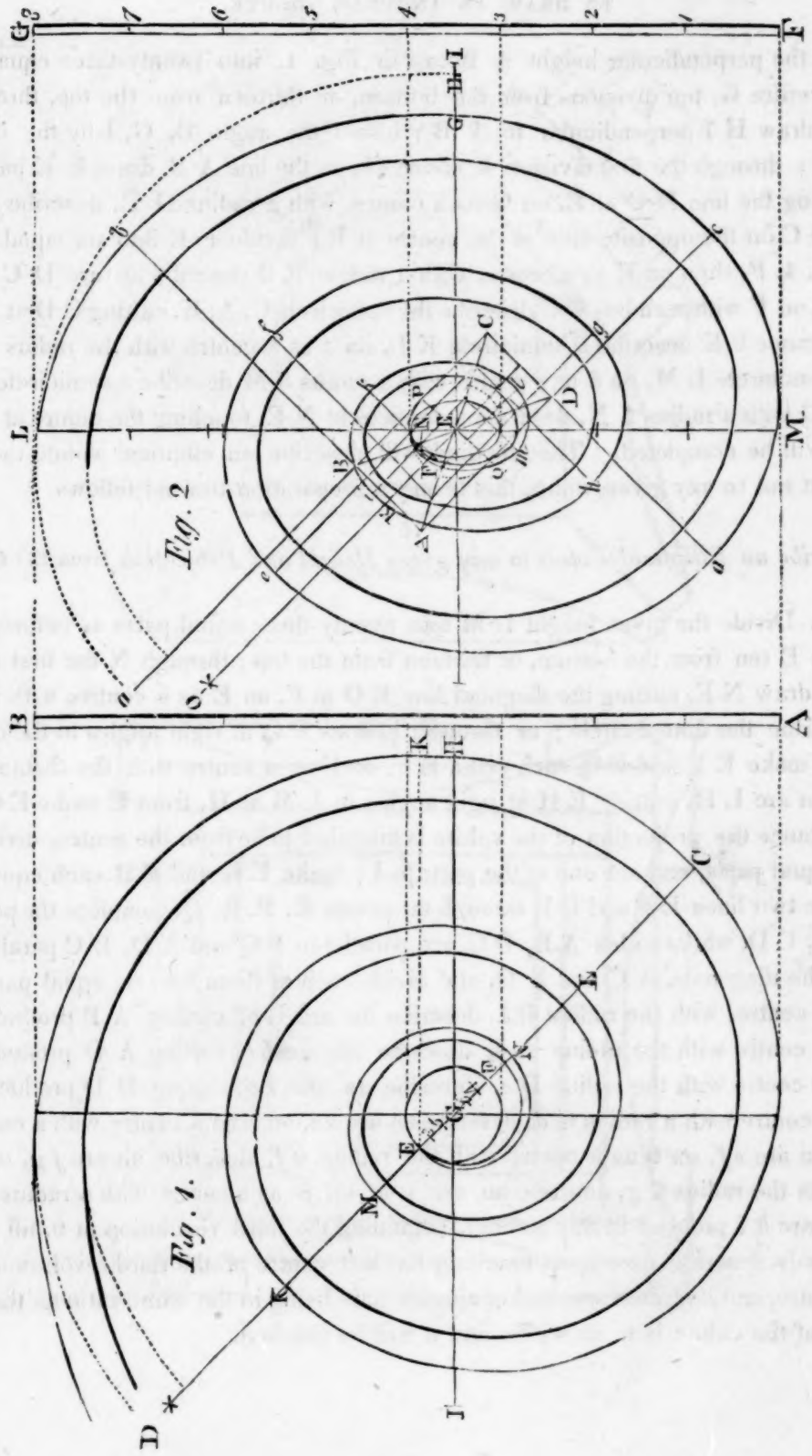


PLATE XXIX.

TO DRAW AN ANGULAR VOLUTE.

Divide the perpendicular height A B, as in Fig. 1. into twenty-three equal parts; take the centre G, ten divisions from the bottom, or thirteen from the top, through the centre G draw H I perpendicular to A B; bisect the angle B, G, I by the diagonal line D, C; through the first division K above H, on the line A B, draw K E parallel to H I, cutting the line D C at E, on G as a centre, with a radius G E, describe a circle cutting D C on the opposite side of the centre at F; divide F E into six equal parts at 3, 5, G, 6, 4, F, then on E as a centre, with a radius E B describe an arc D C cutting D C at C, on F with a radius F C describe the semicircle C, A, K, cutting C D at K, on 3 with a distance 3 K describe a semicircle K L, on 4 as a centre with the radius 4 L describe a semicircle L M, on 5 as a centre with a radius 5 M describe a semicircle M N; lastly on C with a radius 6 N, describe a semicircle N E, touching the centre at E, then figure 1 will be completed. This method will describe an elliptical volute to a given height, but not to any given width, this is only a preparation to what follows.

To describe an Elliptical Volute to any given Height and Projection from the Centre.

Fig. 2. Divide the given height L M into twenty-three equal parts as before, taking the centre E ten from the bottom, or thirteen from the top; through N the first division above E draw N F, cutting the diagonal line E O at F, on E as a centre, with a radius E F, describe the dotted circle; or through E draw P Q at right angles to the diagonal line O E, make E P and E Q each equal E F, on F as a centre with the distance L F, describe an arc L H, cutting E H at right angles to L M at H, from E make E G equal to the distance the projection of the volute is intended to be from the centre, divide G H into six equal parts, and set one of the parts to I; make E K and E R each equal to the sum of the two lines E F and G I, through the points K, P, R, Q, complete the parallelogram A B, C D, whose sides A B, D C, are parallel to P Q and A D, B C parallel to K R, draw the diagonals, A C and B D, and divide each of them into siz equal parts, then on B as a centre, with the radius B L describe the arc L *b*, cutting A B produced at *b*, on A as a centre with the radius A *b*, describe the arc *b c*, cutting A D produced at *c*, on D as a centre with the radius D *c*, describe an arc *c d*, cutting D D produced at *d*, on C as a centre with a radius C *d*, describe an arc *d e*, on 5 as a centre with a radius 5 *e*, describe an arc *e f*, on 6 as a centre with the radius 6 *f*, describe an arc *f g*, on 7 as a centre with the radius 7 *g*, describe an arc *g h*, on 8 as a centre with a radius 8 *h* describe an arc *h i* proceed in this manner, beginning the third revolution at 9, till you end at 12; lastly describe an ellipsis touching the last centre of the third revolution E, being its centre, and its transverse and conjugate axis being in the same ratio as the length or height of the volute is to its width, and it will be finished.

METHODS OF GLUING UP IONIC CAPITALS.

Plate 30.

Fig. 1.

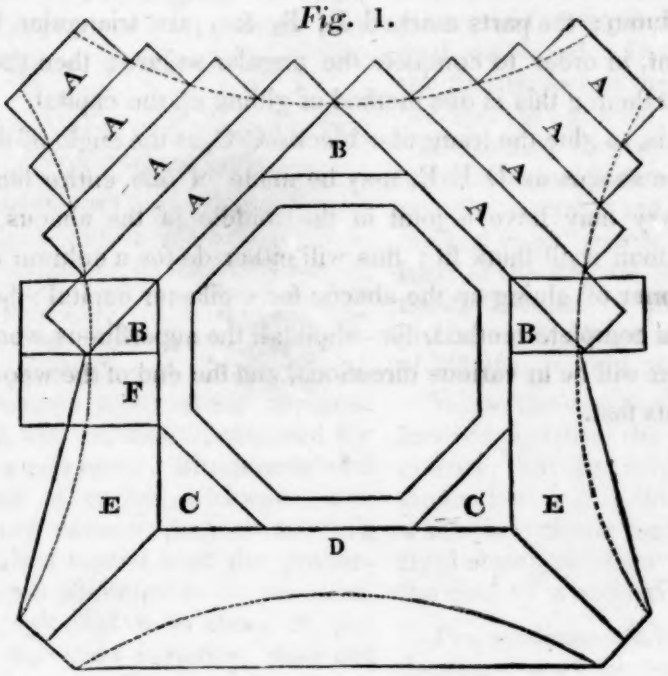


Fig. 2.

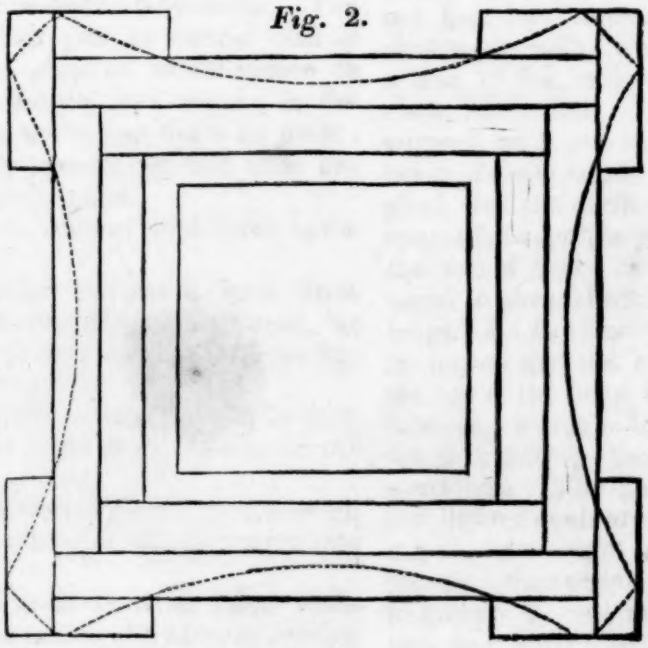


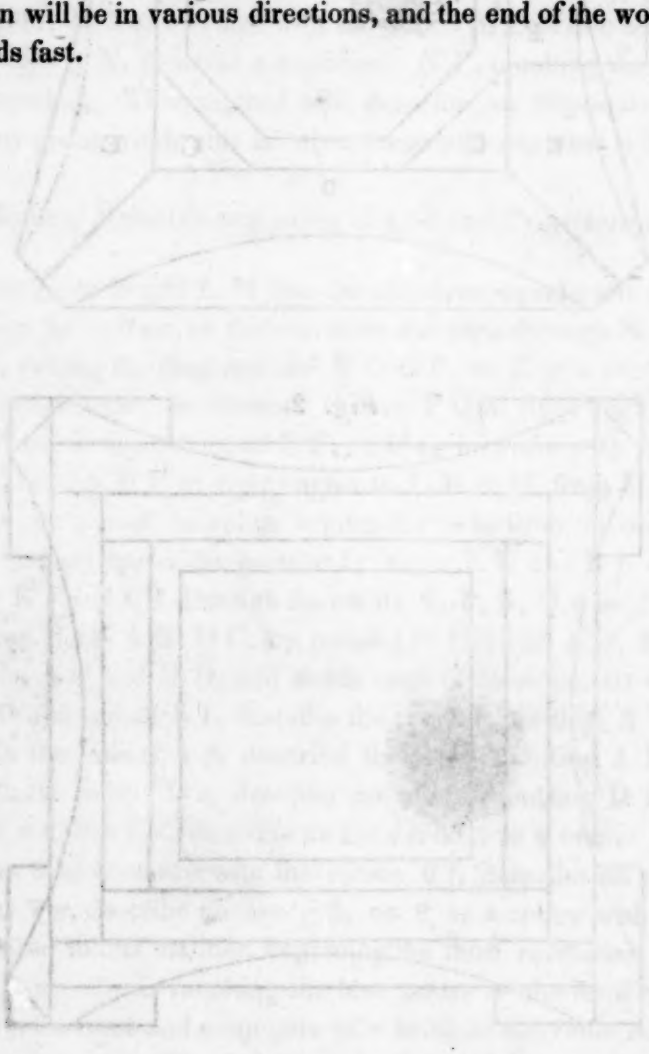
PLATE XXX.

THE MANNER OF GLUING UP THE IONIC CAPITAL.

Fig. 1. for a column; the parts marked B, B, &c. are triangular blocks of wood, glued upon the front, in order to complete the angular square; then the pieces A A A, &c. are glued upon them; this is one method of gluing up the capital.

Another method is, to glue the triangular blocks C C, at the angle of the abacus; then the four sides of the abacus as D E E, may be made of one entire length, and mitred at the horns; or they may have a joint in the middle of the abacus, where the rose comes, as the workman shall think fit; this will either do for a column or pilaster.

Fig. 2. is a manner of gluing up the abacus for a pilaster capital; but in my opinion it is far from being a complete method, for when all the superfluous wood is worked off, the joints at the horn will be in various directions, and the end of the wood butting against the grain never holds fast.



APPLICATIONS OF CHEMISTRY TO THE USEFUL ARTS, BEING THE SUBSTANCE OF A COURSE OF LECTURES DELIVERED IN COLUMBIA COLLEGE, NEW-YORK, BY JAMES RENWICK, PROFESSOR OF NATURAL EXPERIMENTAL PHILOSOPHY AND CHEMISTRY.

V.

CARBON, HYDROGEN AND THEIR COMPOUNDS.

(Continued from August No.)

4. MANUFACTURE OF COKE.

AUTHORITIES.—KARSTEN. Metallurgie de Fer.
DUMAS. Chimic appliquee aux Arts.
BEAUMONT and DUFRENOY. Voyage Metallurgique.

Rationale.—Coke bears the same relation to bituminous coal, which charcoal does to wood, and is, like it, obtained by distillation at a red heat. Bituminous coal is a compound of carbon, hydrogen, and oxygen, in very various proportions. In the variety called cannel coal, the proportion of hydrogen amounts to 5½ per cent. in the Liverpool coal it is about 3¼ per cent., and in the slaty varieties does not exceed one per cent. The quantity of carbon varies from 75 per cent. in cannel coal, to 90 per cent. in that of Newcastle. The proportion of oxygen in cannel coal is about twice as great as would suffice to convert the hydrogen into water; in the Newcastle coal about four times as great; and in the slaty varieties, it but little exceeds the proper relation.

Coals may be divided into three varieties:

1. Those which contain at least three per cent. of hydrogen, and, at most, as much oxygen as will convert half the hydrogen into water.

2. Coals which contain oxygen in such quantity as to convert two-thirds of the hydrogen into water.

3. Coals which contain oxygen enough to convert the whole of the hydrogen into water.

The first of these varieties fuses when heated, and the excess of hydrogen uniting with a part of the carbon, escapes in the gaseous form; by the formation and escape of gas, the coke is rendered light and porous. The second variety fuses also, but the quantity of gas formed is not sufficient to render the coke porous, it is therefore compact and massive.

The third variety does not fuse, and the escape of the vapor of water reduces the mass to the form of powder.

Coal of the first class increases in volume when it is coked; the other two varieties yield coke in less volume than the coal employed. In their uses in the arts, the first furnishes the most valuable coke; the last that of least value.

Coke may be prepared in iron cylinders or retorts, but this is only done when the volatile products are to be collected; this method will therefore be described when we treat of the preparation of gas for illumination. Treated in this way, cannel coal yields about 50 per cent. of coke, and that of Newcastle as much as 80 per cent.

When the distillation is performed at a low temperature, the weight of coke is increased, but its volume and porosity are diminished. It is therefore advantageous, when the volatile matters are not the principal object, to effect the decomposition of the coal by a sudden and high heat.

Preparation.—When coal is rich in hydrogen, it may be readily coked in heaps resembling the *pits* used in preparing charcoal. The coal must be in pieces having not less than three or four inches in each dimension. The heaps are conical, having a base 15 feet in diameter, and a height of about 30 inches. The heap may be best covered with straw, on which is laid a layer of moist earth, the straw being so applied that the earth cannot enter into the spaces between the pieces of coal. But as the use of straw is expensive, it is more usual to cover the large coal for about the height of a foot from the ground with smaller pieces, and the outside with coal-dust; the top of the heap is covered with the refuse coke which is left in the form of powder, in handling that obtained in previous operations. The heap being finished, a few lighted coals are dropped into an opening of six or eight inches in depth left in the top; the space is then filled up with fragments of coal, and when the combustion has fairly commenced, the whole is covered with earth or refuse coke. The rest of the process is much the same as that of preparing charcoal, but is easier, as coal when in mass will not continue to burn after the gaseous matter has escaped, unless new surfaces be exposed to air.

In heaps of greater diameter and height

than we have described, the combustion would be too slow at first to form a porous coke, and so rapid at the end as to render it difficult to extinguish. Yet so large is the quantity of coke which is required in some instances, and particularly in the manufacture of iron, that heaps of so small a size would be attended with inconvenience. The shape of the heap is therefore changed in such cases from a cone to a long prism. The breadth of this must not exceed 15 feet, nor its height 3 feet, but its length may be unlimited. This prism must be set on fire in the mode we have mentioned at several points on its upper edge. In this way not only may a greater quantity of coke be prepared at a single operation, but the time is shortened, the conical heaps requiring three or four days for their conversion into coke, while the prisms are finished in 24 hours.

The product is usually about 40 per cent., but some coals, that of Virginia for instance, yield 50 per cent. If a coal, in consequence of its containing but little hydrogen, does not burn freely, it cannot be converted into coke in this way. Such a coal was found in Yorkshire, (England,) in association with minerals which would render the manufacture of iron profitable. In order to apply it to this purpose, an intelligent manufacturer (Wilkinson) imagined the application of a chimney, for the purpose of obtaining a more powerful draught. This chimney is conical in form, about a yard in height, and as much diameter at bottom; the diameter at top is two feet; it is built of brick, the lower courses of which are laid in such manner as to leave openings. Around this chimney the coal is piled in a heap, whose radius is about 6 feet greater than the outer radius of the chimney. This heap is composed of alternate layers of large and small coal, the lowermost layer being of pieces of the largest size. The surface of the heap is covered with ashes or refuse coke, and fire is applied by throwing burning fuel into the chimney. Wet ashes are kept on hand to close any cracks which may occur in the cover of the heap. Dense smoke flows from the chimney, and is followed by a blue flame; as soon as this appears, the top of the chimney must be closed by a plate of cast iron and the combustion will speedily cease.

The coal of Pittsburgh, Pa., as far as we can learn, must resemble in quality the coal employed by Wilkinson, for although far removed in character from anthracite, it has not hitherto been converted into coke by the use of the mode first described. We cannot but express our belief that the method of Wilkinson would be found sufficient for the purpose and that by its aid the manufacture of iron from the ores might be introduced into that city, which at present receives almost all the pig iron used in its extensive foundries and forges, from the opposite side of the Alleghany range of mountains.

This method has also been introduced, with some modifications in Staffordshire, where the coal is of better quality. Here the coarser coal is placed in contact with the chimney, and the finer at the outside of the heap, the whole being covered with ashes or refuse coke, leaving a few openings for the admission of air. As soon as the coke is finished, water is poured on the heap to extinguish the combustion. In this way the product of coke is raised from 40 to 50 per cent.

All the methods of which we have spoken require that the coal should be principally of that size which is of most value for other purposes, namely in coarse fragments. Much however of all good coal is reduced to dust in its extraction from the mines, and in the handling it must undergo. This, in most parts of England, is totally lost, and it has even been necessary to burn it in heaps in order to get rid of it.—In France, where coal is more scarce, and consequently of more value, it has become an important object, that none but such refuse coal should be converted into coke, and the coarser pieces left to be employed for other purposes. This object has been successfully accomplished in the neighborhood of St. Etienne.

The heap in which the coal is burnt may have the form either of a truncated cone or oblong truncated pyramid. The latter form is the most easily constructed, and described. A case of plank is formed, having the desired figure, say a base of 50 or 60 feet in length by 4 feet in breadth, a height of 3½ feet; and the planks are so inclined as to make the dimensions of the upper surface two feet less in each direction than that of the base.

The planks which form the ends of the case are each pierced with four holes: one

at the base, one directly over it and near the top, the other two at half the height of the plank, and in the vertical plane of the upper edge of the sides. Each side is also pierced with three ranges of holes, having the same arrangement in quincunx as those of the ends, and at the same distances.

These holes serve for the introduction of tapering spars. The spars of the lowermost layer are passed through the holes in the sides and ends, at right angles to the respective direction of these surfaces, and at the angles where the spars meet each other, vertical spars are set up. The second range of spars is inclined to the sides in such manner as to meet the vertical spars; and the third layer has the same direction as the first.

The fine coal is prepared by mixing it into a paste with water, by means of a hoe. It is then thrown into the case, and well rammed upon the lower range of spars, until a bed has been formed to receive the second range of spars. This latter range being placed, more coal is thrown in and rammed, until the height of the third range of spars has been reached, and this being introduced, the rest of the case is filled in the same manner.

In order to lessen the expense of the wood employed, the heap may be built in successive portions, each ten or twelve feet in length, and when one portion has been finished, the planks and spars are removed to enclose and form passages in a second portion. The spars form conical passages in the mass, by which air may be admitted during the combustion. When the heap has thus been completed and covered with ashes and refuse coke, all the wood is removed, and the heap is set on fire by igniting small heaps of coarse coal upon each of the openings left in the upper surface by withdrawing the vertical spars. It has been found that in pyramidal heaps, about $\frac{1}{20}$ part of the coal to be coked is required for this purpose; but in small conical heaps, where a single vertical spar will suffice no more than $\frac{1}{40}$ will be used.

The attention of the workmen must be directed not only to close the cracks which may appear in the cover, but to keep the passages left by the spars open by means of iron rods. The completion of the process is known by the cessation of the flame. Water is then introduced into the lower passages, whose steam in passing through the incandescent heap is decomposed, and furnishes hydrogen which escapes in flame. The heap is then covered closely with earth, and left until it cools.

In this way coal which would otherwise be lost, yields 50 per cent. of coke of excellent quality.

When coal of the first variety (with the exception of cannel coal) is distilled in close vessels it yields from 70 to 80 per cent. of coke, by the combustion of about ten per cent. of coal. As the best of the methods we have yet described yields no more than 50 per cent., and the most common of them no more than 40, there is obviously a very great waste. In the neighborhood of coal mines this is more than compensated by the simplicity and facility of this process. But at a distance from mines a more economic process is necessary, unless coke can be transported from this vicinity, which is by no means easy, in consequence of its friable character, and its being liable to injury by being wet. The best apparatus for this purpose is called the coking oven. This is formed of a cylindrical wall about 2 feet in height surmounted by a dome, from the summit of which rises a chimney about 18 inches in height. In the circular wall is a door about 18 inches by 12 inches, having an iron shutter. The coal is introduced through the chimney, and spread by a rake over the floor, to an uniform depth of about 4 inches. Burning coals are then dropped through the chimney, and as soon as the ignition is fairly commenced the door is closed. When a blue flame begins to appear at the chimney, the top of it is closed by a plate of iron. In this method about one half more coke is obtained than by the ordinary heaps.

Large spheroidal kilns, and reverberatory furnaces have also been used, but their principal object was the preparation of the coal tar. As this article has not proved to be of any great value, and is besides produced at gas-works in quantities greater than can be consumed, it is unnecessary to describe these kilns and furnaces.

It may be here mentioned that turf or peat may be carbonised as well as coal or wood. The fuel thus produced is of very excellent quality, and may be applied to the same purposes as that obtained from wood or bitumnious coal.—Pits as used in preparing charcoal have not been found well adapted to the preparation of the charcoal of turf. The little that has been made of good quality was prepared in iron cylinders, but as this is too expensive for manufacturing purposes, it appears probable that if it should ever be necessary to carbonise turf on a large scale it will be done in kilns like those described under the head of charcoal.

5. LAMP-BLACK.

AUTHORITY.—Encycolpedie Methodique.—Arts at Metiers.

Lamp-black derives its name from its having been originally obtained by collecting the soot of lamps. This method is still used in some cases. Linen wicks are immersed in linseed oil and lighted; the smoke is received in a copper vessel on which the soot is deposited. What is called ivory black was made at first by receiving the smoke of similar wicks upon plates of ivory.

At present lamp-black is manufactured on a large scale, by burning refuse resinous substances, or even from the soot of coal. When resinous matters are employed, they are placed in a kettle over a furnace, and free access of air is admitted over the mouth of the kettle. The resinous matter being heated fuses at first and finally takes fire, giving out a dense smoke. This smoke instead of being carried off by a chimney, enters a lofty circular chamber; the roof of which is conical with a single opening in the centre. From this roof a cone of sheet iron is suspended by a pulley, and nearly fills up the area of the chamber; this cone has also an opening in the centre. The interior of the chamber, and the lower surface of this cone are covered with coarse woollen coth or with sheep skins. Upon these the soot settles, and may, when the combustion is over, be separated by drawing the sheet iron cone up and down by means of the pulley.

Lamp-black is extensively used as a paint, and there are other forms of vegetable charcoal which are applied to the same purpose. Even common charcoal reduced to powder is sometimes so employed.

Blue black is formed by burning the kernels of the peach in crucibles, to which the covers are carefully luted, with but one opening for the escape of the gas.

A very fine black is made by treating the twigs and tendrils of the vine in the same manner. The article called black chalk, and used in the manufacture of crayons, or for drawing, without preparation is the charcoal of a shrub (*fusain*) which grows in France.

The black used in Europe by engravers is made from a mixture of wine-lees, peach-pits, ivory and bone, calcined and ground to powder. It is prepared for use by making it into a paste with linseed oil.

6. ANIMAL CHARCOAL.

AUTHORITIY.—DUMAS, Chimic appliquee aux Arts.

History.—In the preceding section we have mentioned the original mode in which ivory-black was prepared. For that method, the calcination of fragments of ivory in close vessels was substituted, and it was speedily found that an article little inferior was to be obtained from bones. Still, so long as the sole use to which either was applicable was in the art of painting, this observation was of little value. At the end of the last century, however, it was discovered that carbon, in any form, had the property of discharging the colors, taste and smell of liquid vegetable substances. Common charcoal was at first used for this purpose, but in 1811 it was discovered by a chemist in the south of France, that animal charcoal was much more powerful in its effects, and was capable of separating rapidly and certainly, vegetable coloring matter from any liquids whtasoever. Since that time the manufacture of animal charcoal has risen to great importance, and we shall hereafter have occasion to cite several important applications that have been made of it in the arts.

Preparation.—Animal charcoal is usually prepared from bones, and at the same time ammonia is obtained. We have had occasion to refer to this process under the head of that alkali. Some farther details are,

however, necessary. The carbonisation of bones is performed in cast iron cylinders, similar to those used in the manufacture of nitric and muriatic acids. The tube which conveys off the volatile matter must be three inches in diameter, and connected with a series of three necked bottles.—The opposite end of the cylinder to that where the tube issues is closed by a dish, which has no opening in it. The bones are broken to pieces and freed from the fat by boiling. They are placed in the cylinders and kept at a red heat for thirty-six hours; at the end of this time they are taken out, and shut up in close vessels to prevent combustion, until the charcoal is cold. The charcoal is then stamped into coarse powder, and finally ground between millstones into fine meal.

If it is to be used as a paint, it is again ground with water, and then dried in earthen moulds. Another form of animal charcoal which was formerly lost, is that left in the preparation of Prussian blue. In this manufacture blood is calcined with potash, and the charcoal is obtained by washing off the alkali.

APPLICATION OF ANIMAL CHARCOAL TO THE DISCHARGE OF VEGETABLE COLORS.

The action of charcoal in discharging colors seems to be owing to the same cause as its power of condensing gasses; of one of which it takes up 90 times its own bulk. The action in this case is due to a mechanical attraction, and to this we may ascribe its powers of retaining the coloring matter of liquids filtered through it. Animal charcoal, upon this theory, owes its superior effect to its greater degree of division; this minute separation of its parts is evident from the fact, that the actual carbonaceous matter in calcined bones does not exceed ten per cent. and is yet sufficient to give its intense black color to the remaining mass of phosphate and carbonate of lime. In that obtained in the manufacture of Prussian blue the division is still more minute, as it is in fact a chemical precipitate from the blood employed, it has for this reason a still more powerful effect. In consequence of this divisibility a larger surface is provided by which the attraction may be exerted.

The liquids which best evince the powers of charcoal in discharging colors, are the solution of indigo in sulphuric acid and molasses. The relative powers of different forms of charcoal on these solutions are exhibited in the following table, the power of that obtained from bones, without further preparation being taken as the unit.

	Indigo.	Molasses.
1. Calcined bones,	1.00	1.00
2. Soot of vegetable oil fused with artificial phosphate of lime,	2.00	1.90
3. Calcined bones from which the phosphate of lime has been washed by muriatic acid,	1.87	1.60
4. Calcined bones again calcined with potash,	45.00	20.00
5. Albumen or Gelatine calcined with potash,	35.00	15.50
6. Blood calcined with potash,	50.00	20.00

In order to render the above table useful it is to be stated that a given quantity of calcined bones will discolor the solution of one thousandth part of its weight of indigo, or nine times its weight of molasses. After producing this effect it will not act again until the coloring matter absorbed has been separated by calcining the charcoal a second time.

As an instance of the use of these substances in the arts, we may cite an article well known in our markets. The made wine, called Marseilles Madeira, is prepared from the common red wines of the south of France. Their deep color is discharged by filtering them through animal charcoal, and they are made up to the American palate by the addition of brandy. The peculiar smell and taste of the original wine is discharged at the same, and it is thus ready to receive such as may be given it artificially.

Animal has similar advantages over common charcoal in the rectification of spirituous liquors. By its use, all the peculiar and often offensive taste and smell of these liquors may be separated. We shall have occasion to treat of these uses of charcoal under their proper heads.

A carbonaceous substance, having powers in these respects about equal to calcined bones, has been prepared from a species of shale charged with bitumen, which is found in some geological formations, and particularly in the strata of coal fields. In

the separation of the volatile matter the shale becomes extremely porous. It is therefore well adapted to the construction of filters, which may be made of slabs of the carbonised rock.

7. GAS-LIGHT.

Rationale.—Bodies which burn with flame must be either volatile, or capable of furnishing a gas when heated. Thus, phosphorous and sulphur burst into flame, when heir vapor escapes freely, and the vapor of alcohol is readily ignited. Any aeriform body whatsoever, if intensely heated, assumes the appearance of flame. In oleaginous, resinous, and bituminous substances, a red heat causes a decomposition, and new combination of their elements; these new combinations are both gaseous and volatile, are readily ignited, and in burning form flame. Thus in a common fire of bituminous coal, bitumen is first formed; this is again decomposed by the heat, yielding tar and gaseous carbeurts of hydrogen; the former yields vapor, which in mixture with the gas burns with flame. In a common lamp or candle, the wick composed of inflammable matter readily takes fire; the heat thus produced melts the tallow, when that is used; the liquid tallow, or oil, is drawn up by capillary attraction into the pores of the wick, and coming in contact with its ignited part, is decomposed and yields carburetted hydrogen; this is et on fire by the ignited wick, and flame is formed.

Gases do not become luminous, nor assume the appearance of flame, except at very high temperatures, far higher, indeed, than those at which solid bodies become luminous. If then, a gas, when heated in the act of combining with oxygen, so far as to become luminous, should deposite a solid body, or if the product of the combustion should have the solid form, the flame will be brilliant; but if the product of the combustion remain in the state of gas or vapor, the flame will give but little light.

Thus, when phosphorus is burnt, the whole product is solid, and the flame has the greatest brilliancy of any that is known; when heavy carburetted hydrogen, (olefiant gas) burns, a part of its carbon is deposited, which, disseminated through the flame in a solid form, gives it the lustre due to an intensely heated solid; but when hydrogen or alcohol are burnt, even by the aid of a stream of oxygen, which causes the greatest heat of any known combustion, the flame will have so little brilliancy as to be hardly visible in the bright light of day, because the products are aqueous vapor and carbonic acid gas.

Combustible bodies may not only be decomposed directly in a fire, or by the aid of wicks, but they may be heated in close vessels, and the gases which are evolved may be kept in proper reservoirs until needed for the purpose of illumination.—From these vessels they may be carried in pipes to the place where the light is needed, and inflamed by an ignited substance as they issue from beaks of some convenient form.

When combustible bodies, whose principal constituents are carbon and hydrogen, are decomposed by heat, these elements may be either wholly separated or may enter into new combinding. The products are therefore carbon in the solid form which remains in the apparatus where the decomposition is performed; hydrogen uncombined; light carburetted hydrogen, olefiant gas or heavy carburetted hydrogen; liquid carburets of hydrogen; and tar. In the present case the resdiuum of carbon need not be spoken of, nor would we have any thing to add to what has been stated under the heads of Coke, and the several varieties of charcoal. Hydrogen has the smallest density of all known bodies, and in burning produces the most intense heat; but as the product of its combustion is aqueous vapor, and that extremely rare in consequence of being generated at a very elevated temperature, the flame has so little brilliancy as to be hardly visible in the light of the sun. Light carburetted hydrogen is a compound of one equivalent of carbon to two of hydrogen. The density of the compound is increased to eight times that of hydrogen, or the numbers which respectively represent these specific gravities are 1 and 8. In a close vessel it is not affected by a heat below one approaching to whiteness; but at a white heat or a little below, it is decomposed, and deposites its carbon. When burning freely, sufficient heat is generated to produce this decomposition, and the carbon deposited in the flame having the solid form, and therefore becoming

more luminous than the hydrogen or the aqueous vapour which that gas forms, gives brilliancy to the flame. Light carburetted hydrogen is not absorbed by water to any appreciable extent.

Olefiant gas contains twice as much carbon as light carburetted hydrogen, and may be considered as a combination of one equivalent of each of its constituents; the volume of the hydrogen is reduced one half, and the density of the compound is fourteen. Even at a low red heat, olefiant gas begins to decompose, depositing half its carbon, and being thus converted into light carburetted hydrogen whose density is lessened in the relation of 8 to 14. At a full red heat it is completely decomposed. In burning therefore it deposites twice as much carbon from an equal weight of gas, furnishes a flame of equal size to that of twice its bulk of hydrogen, and which is far more brilliant, in consequence of the quantity of carbon deposited in the flame being twice as great.—Olefiant gas is therefore the most valuable of those generated by the decomposition of combustible bodies, and in the manufacture of them every exertion should be made to obtain it in the greatest quantities, which the nature of the material will admit, and to preserve it from waste after it is formed. The most obvious cause of waste is its having a greater degree of solubility in water, than the light carburetted hydrogen or pure hydrogen; water taking up one eighth of its own bulk.

Two liquid carburets of hydrogen were discovered by Faraday to exist in gas. These are very volatile, one of them boiling at 60 Fahr. and the other as low as the freezing point. Both of these may therefore exist in vapor at mean temperatures, and the latter under almost all circumstances. They both contain more carbon than olefiant gas, and therefore furnish a flame of greater brilliancy, but it may happen that all the carbon they deposite is not consumed, and thus, too great a proportion of them may take the form of smoke.

The vapors of these carburets agree with olefiant gas in one property, viz., they are decomposed by chlorine, rapidly and without the aid of light, while hydrogen, and light carburetted hydrogen, are condensed by it more slowly. As these vapors and olefiant gas are more valuable for illumination, the measure of the quantity of a given mixture which is condensed on the first application of chlorine is the best of all tests for the value of gas intended for illumination.

Another liquid carburet, analogous to Naptha is likewise produced in the decomposition of coal. As this does not boil below 180°, but little of its vapor can be present at ordinary temperatures; but if present it produces a dense smoke, except in burners of the best form.

The tar need only be mentioned here in consequence of its being capable of decomposition by being returned to the apparatus, and thus of yielding the gaseous and volatile compounds just spoken of. In the laboratory, or under circumstances where the heat may be carefully regulated, the character of the products may be varied to a very great extent. From bituminous substances little else but tar may be obtained, and oleaginous substances will yield little but their own vapor, if the apparatus be not permitted to become red hot. If allowed to rise to a low red heat, olefiant gas, and the two volatile carburets will become the principal products; at a higher heat light carburetted hydrogen; and at a white heat uncombined hydrogen. In the successive stages of the process, the several substances will come over mixed in various proportions, and each in its turn will cease to appear.

In manufactories on the large scale, such nicety is impracticable, nor is it ever necessary. It is then sufficient to divide the matters which are used into two classes, each of which requires a peculiar management.

The first class comprizes those substances which do not decompose rapidly until the light carburetted hydrogen is formed. These must be subjected to a full red heat; for an attempt to obtain the more valuable compounds would be attended both with delay and a waste of the material. Still as some olefiant gas will be formed, no more water should be used in purifying them than is absolutely necessary to remove offensive matter.—Coal is a body of this class.

The second class comprizes those which may be decomposed with sufficient rapidity, at a temperature consistent with

the existence of olefiant gas. These ought to be treated at the lowest temperature which will ensure the decomposition of their own vapor; one which merely gives a red glow to the surface of the iron vessel used in the process is sufficient for the purpose. To this class belong oils, and the solution of rosin in spirits of turpentine.

History.—The adaptation of a wick to oil or tallow, in order to obtain light by the decomposition of these substances, and the ignition of the gases and vapors they yield is among the oldest of human inventions. On the old continent neither tradition, written history, nor even mythological fable reach the epoch of its discovery.—Yet it must have been introduced prior to the separation of the races which peopled the two continents; for while in the ancient world there is no tribe so rude and savage as not to be acquainted with the use of the lamp, even the polished nations which occupied Mexico and Peru were ignorant of it. The only inhabitants of the Western hemisphere who used wicks were the Esquimaux, and if they be an ancient American race, they may have derived this information from Greenland, which was peopled at a remote era by a Norwegian colony.

The idea of separating the two processes which take place in the wick, effecting the decomposition at one time, and storing up the gases for use did not appear to have occurred to any one until the year 1785, when it was proposed by a French engineer of the name of Lebon. This was applied to the distillation of wood, and he endeavored to collect at the same time the pyrolignous acid which was evolved. It does not appear that this use of his invention was attended with any valuable result. In this country, however, about 30 years ago, the apparatus of Lebon was manufactured in Baltimore, and occasionally used for the distillation of bituminous coal. The retort employed was of the shape of a flower pot and made of iron; to this a cover was fitted by grinding, whence a pipe proceeded; and the pipe was usually divided into two branches each of which terminated in a burner. The retort being filled with coal was set in a common fire, and the gas ignited when it began to escape from the burner. In order to prevent the offensive smell of the gas from being apparent, the lights were kept beneath the chimney.

Previous to the year 1806 the factories of Watt and Bolton at Birmingham, and of Philips and Lea at Manchester were lighted by gas obtained from coal; and in the ten years succeeding, it was generally introduced into all the large manufactories of Great Britain. It was also occasionally used in smaller establishments, and in particular at Ackerman's in London, whose example had a powerful influence in bringing it into public notice. When first applied, no attempt was made to purify the gas, its use was therefore extremely offensive, and by no means wholesome. During the ten years of which we have spoken the character of the gases evolved in the decomposition of coal were chemically examined, and by the aid of science, the mode of separating every offensive substance, and most of those injurious to combustion discovered.

In 1815, some streets in London were lighted by coal gas distributed in pipes, and in 1816 the method became general in that city.

In 1817, Taylor and Martineau began the decomposition of oil, which, when properly treated, yields a gas of far greater illuminating power than is given by coal. Previous to this time Mr. David Gordon, a gentleman for many years a resident of the United States, had proposed to render gas portable by condensing a number of atmospheres in strong metallic vessels. So long as no gas but that from coal could be obtained the method promised but little success. On the introduction of oil gas however, the plan was resumed and carried into successful operation. By this method, ships, steamboats, railroad and other carriages may be furnished with the beautiful and safe light given by oil gas; and if it was compelled to give way before the immense capital vested in coal gas manufactures in the British capital, there is little doubt that it might be applied to advantage in a new and open field; particularly in countries where coal bears as high a price as it does in most of our Atlantic cities.

The manufacture of gas from rosin as now usually conducted, was the invention of Professor Daniell of King's College, London. It has, however, been conducted

on a large scale no where except in the city of New-York. Mr. Rembrant Peale was however, probably the first who prepared gas from this material, although he treated it in a different manner. The Museum in Philadelphia was lighted under his direction by gas prepared from rosin as long ago as 1814.

a. Coal Gas.

Rationale.—Bituminous coal is composed of carbon and hydrogen in variable proportions. It also contains sulphuret of iron, and according to some, oxygen and nitrogen. We are, however, rather inclined to ascribe the presence of the former partly to the water mechanically combined with the coal, and partly to atmospheric air which cannot be entirely excluded. The latter may also be accounted for, at least in part, by the presence of atmospheric air.

When bituminous coal is distilled at a red heat its elements enter new combinations, the greatest number of which are volatile, although the carbon which is left is greatest in quantity. The volatile products are partly gaseous and partly condensible. The condensible products are:

1. Water, arising from the moisture of the coal, or a new combination of its elements;
2. An oil of the character of Naptha;
3. Tar;
4. Sulphuret of carbon.

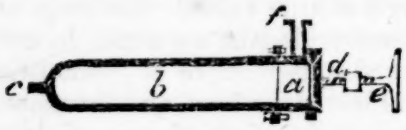
The gaseous products are:

1. Hydrogen, Light Carburetted Hydrogen, and olefiant gas, being new combinations of the elements of the coal;
2. Carbonic oxide, } arising from the
3. Carbonic acid, } combustion of the carbon of the coal in the atmospheric air which cannot be excluded;
4. Sulphuretted hydrogen, formed by an union of the sulphur of the sulphuret of iron with a part of the hydrogen of the coal;
5. Sulphurous acid formed by the sulphur of the sulphuret and atmospheric air;
6. Ammonia; the nitrogen of the air combined with hydrogen from the coal;
7. Nitrogen.

Of the condensible products so much of the oil as can be retained in the state of vapor is advantageous in the combustion, but is apt to be inconvenient and may be dangerous when it condenses in the pipes and burners. The sulphuret of carbon is luckily in small quantities, as it is condensible with difficulty. Of the gases; hydrogen and the carburets of hydrogen are the useful substances for illumination; carbonic oxide burns with a flame of little brilliancy, and is not injurious, although of little value. Carbonic and sulphurous acids, and ammonia do not burn; being also destructive of combustion they would lessen the heat, and therefore impair the brilliancy of the flame. Sulphuretted hydrogen burns, but has a most disagreeable smell, as have also sulphurous acid and ammonia. It is obvious therefore, that the vapors ought to be condensed, and all the gases except the hydrogen, its carburets, and the carbonic oxide separated.—Cooling in a proper refrigerator will effect the first object, and the condensed water will retain the ammonia, with some of the sulphurous acid and sulpuretted hydrogen. Lime has so great an affinity for carbonic acid that it may be employed to separate it, and the residue of the sulphurous acid and sulphuretted hydrogen, being soluble in water might be condensed by washing in that liquid, were it not for the loss thus caused of olifiant gas. In the course of practice it was however, discovered that lime has an attraction for sulphuretted hydrogen, and that its affinity for sulphurous acid is sufficient to cause that gas to be retained. The process of washing is therefore no longer considered absolutely necessary.

Manufacture.—Those coals which, in treating of coke, were arranged in the first class, are alone fit for the preparation of gas. Of these, cannel coal furnishes the largest quantity, and its product is richest in the most valuable gas, the olefiant. Any coal of this class, however, which can be obtained at a low price will answer the purpose. The decomposition was orginally effected in retorts, but is best performed in cylinders of cast iron. As it has been found that the front of the retorts resisted the fire for the longest time, and that the opposite end might be burnt away, while the first remained perfect, they are now usually formed of two pieces. These are united by screw-bolts, and their joint rendered tight by a cement formed of iron-filings sulphur and muriate of ammonia. The front of the cylinder is slightly bevelled, in order to receive an iron stopper.—This is held in its place by a screw adapt-

ed to the middle of an iron bar, which is fastened over the stopper. The pipe by which the volatile matter escapes, proceeds from the top of the cylinder near the stopper. Such a retort is represented in fig. 1.



a, Anterior portion of the retort;
b, Posterior do. do.;
c, Projection, built into the wall of the furnace;
d, Stopper;
e, Screw;
f, Pipe which carries off the gas.

Five such cylinders are usually arranged in one furnace, and the number of furnaces increased with the quantity of gas needed. The several furnaces communicate with a single large chimney, usually of a conical shape; and in some of the best establishments, a separate flue is carried up from each furnace, for a short distance within this cone.

In order to exclude atmospheric air, when any of the retorts are opened for charging and cleansing, and to prevent the reflux of the gas into the retorts where the decomposition is complete, the tubes which convey the gas are bent down into a common receiver, usually of a cylindrical shape and placed horizontally. This cylinder is about half full of water, into which the several tubes dip, each to the depth of an inch. The bend of the tube must be so high above the surface of this water as to prevent the pressure of the gas from forcing the water over it into the retort.

The condenser is formed of a series of cast iron pipes immersed in a cistern of water, which must be kept cool by constant renewal. The pipes must be laid in a sloping position, or communicate with a sloping pipe, in order that the condensed matter may run along them. At the lowest point in this series, a pipe proceeds downwards to a reservoir which receives the condensed substances. In order to prevent the entrance of air, the end of this pipe must be constantly immersed in water. The reservoir will receive by this pipe the tar, water charged with ammonia, with a part of the oil, and of the sulphuret of carbon.

The gaseous matter which remains is purified by bringing it in contact with the hydrate of lime. The first mode used for this purpose, when the separation of the carbonic acid was supposed to be the only purpose which could be effected by means of that earth, was to pass the pipe which proceeds from the condenser downwards, into a close vessel nearly filled with milk of lime. The gas, escaping from the open end of the pipe, rose upwads through the liquid, and was carried off by a pipe issuing from the top of the vessel. When the partial condensation of other gases was found to take place, it became evident that this effect might be increased by bringing larger surfaces of the two substances into contact with each other. This was at first attained by a contrivance by which the liquid was made to fall through the gas in a shower. This apparatus was complex in its form, and as it has been replaced by better methods, need not be described.

In one of these the gas is made to pass through a vessel filled with hay or moss, prepared by wetting, and then dusting it with hydrate of lime in powder. The gas will not pass through this without exerting a considerable pressure, and as it is necessary that it be generated at a low pressure, it is frequently received in a gasometer before it reaches the vessel filled with the purifying material, and drawn from this gasometer by pumps, which force it through the vessel containing the lime.

Even in this mode, the water absorbs a part of the olefiant gas. Hence, a method which has only been practised in one instance, namely, at Perth in Scotland, is to be preferred to any other. In this the gas is caused to descend through a number of successive layers of dry hydrate of lime.—In this instance, from the care with which the heat is regulated, and this improvement in the purification, gas from cannel coal has been made to approach in density and illuminating powers to that yielded by substances of the second class.

From the purifying apparatus the gas passes to the gasometer, which serves as a reservoir, where it is stored up until needed. This has the form and character of the vessels known under that name in laboratories, but is of course of great size.—The cistern of the gasometer may be constructed of brick laid in hydraulic cement, or of flaunched plates of cast iron, which

are connected by screws. The receiver is usually made of sheet iron.

This receiver is counterpoised by a weight suspended from pullies by chains, and the chains are made of such a weight that the part which passes over the pulley as the receiver rises, shall be equal to the weight of the water displaced by that portion of the receiver which is raised from the water during the motion of that part of the chain. In this way the receiver may be always exactly counterbalanced by the weight and the chain.

In some cases the pullies are supported by a hollow column of cast iron, rising from the bottom of the cistern through the middle of the receiver. The receiver has a hollow cylinder of sheet iron formed around its axis for the passage of the column.—The counterpoising weights move within the hollow of the column.

These things being premised, we may proceed to the description of an apparatus for preparing coal gas, with reference to the annexed figure 2.

a, *a*, Retorts.

b, Receiver.

c, *c*, *c*, Condenser, composed of a system of iron pipes, kept cool by a stream of water.

d, Tube by which the coal-tar is discharged.

e, *e*, Vessels in which the gas is purified by means of quick lime.

F, Gasometer, which is represented as being enclosed in a cistern of cast iron.

It is usual to have but one, or at most two, gasometers, and to place them in the immediate vicinity of the place where the gas is manufactured. But it is a much better plan, where a large district is to be supplied with gas, to place in its different quarters separate gasometers, each capable of furnishing the supply of a single night to the nearest burners. These are to be filled during the day time, and for this purpose a single gasometer, of the same size with each of them, will suffice. In this method the large main pipes may be replaced by smaller ones leading to the several local gasometers, and the rest of the distribution effected by small pipes. A great saving will thus arise in the cost of the pipes, and the supply will be more regular. The pipes which convey and distribute gas ought to be laid in the ground to such a depth as to be beyond the reach of any great or sudden changes of temperature. They are made of cast iron, in lengths of about 9 feet. One end of each is cast large enough to receive the smaller end of the next pipe, and the joint is closed by oakum dipped in white lead ground in oil. Melted lead is then run in above this packing. This is called a spiggot and faucet joint. It may be rendered more secure by casting flaunches near the ends of the pipes, and uniting them by screw-bolts and nuts. This method however cannot be adopted when the pipes are liable to endure changes of temperature.

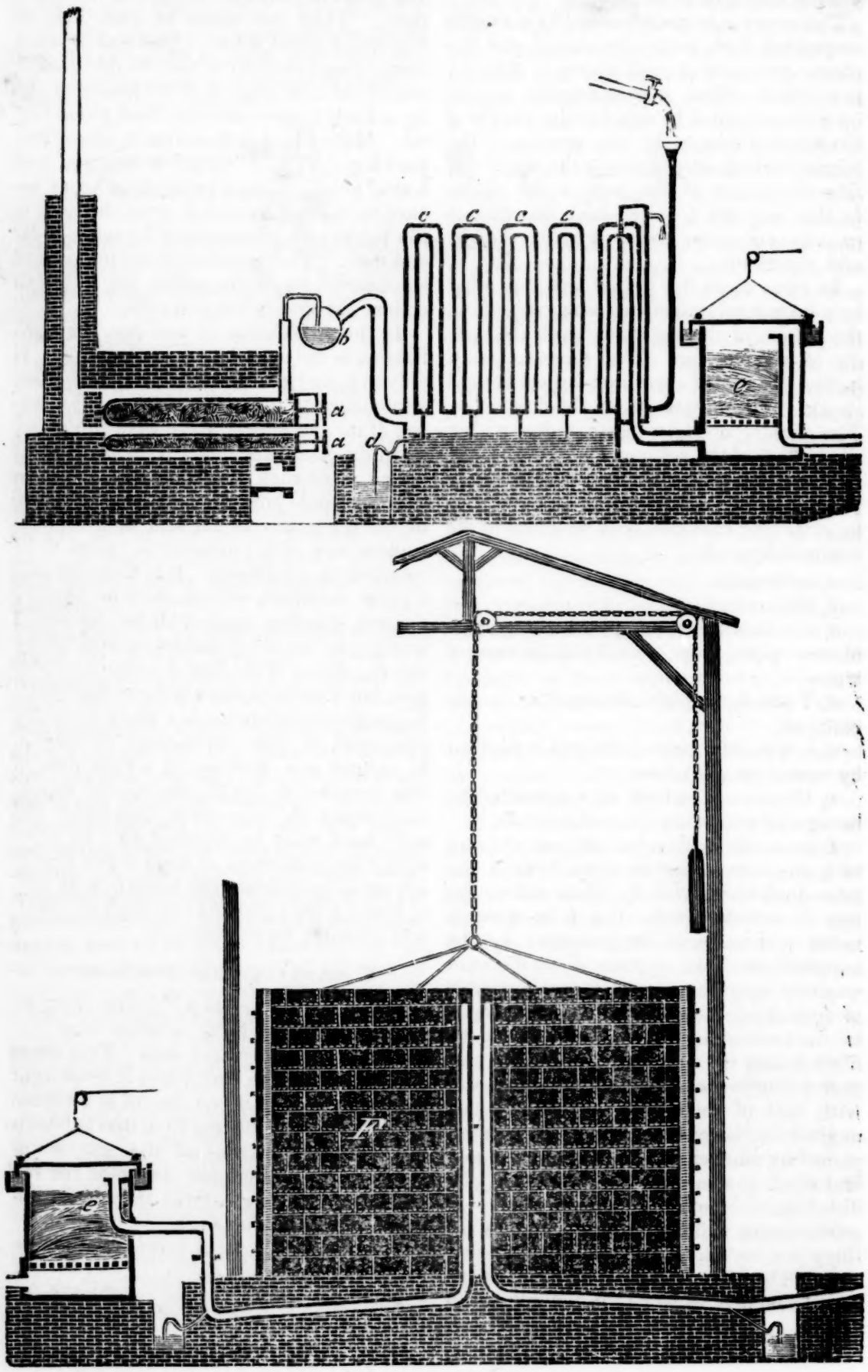
In the preparation of coal-gas, the purification is the most important point. It is only in a single instance that its value has approached to that of good oil-gas, by reason of its containing more than the usual quantity of olefiant gas. The low heat at which alone such a decomposition can be effected would probably lead to an increase in the quantities of tar and naptha, substances now of but little value except to be returned to the retorts. It is therefore still a point on which we can state no positive opinion, whether coal shall be converted into gas in the usual manner, or whether by due regulation of the heat a less quantity of gas, but yielding a more brilliant light, shall be sought, in preference to a gas principally composed of light carburetted hydrogen. If olefiant gas become, by a resolution of this question in the affirmative, the important object, the rules mentioned under the next head must be resorted to. If, however, the production of such a gas should appear to be difficult, the mode now in use, of heating the cylinders to a high red heat, will probably be persisted in.

6. MANUFACTURE OF OIL-GAS.

Oil is decomposed in a cylinder or retort, similar in form and character to that employed in obtaining coal gas. This retort is filled with coke, and when it is brought to a dull red heat, a fine stream of oil is admitted at the end farthest from that to which the pipe which carries off the gas is applied. The oil therefore traverses the red hot coke, and is in a great degree decomposed. The products are,

1. Olefiant gas, light carburetted hydrogen and hydrogen;
2. Vapor of oil;

Fig. 2.



3. The two highly inflammable liquid and volatile compounds of carbon and hydrogen, which have been heretofore mentioned.

The gas in its escape from the retort, passes through the reservoir by which oil is supplied. Here a part of the vapor of oil is condensed. A pipe then conveys it from the upper part of this reservoir to the gasometer. This pipe must have one part of it laid in an inclined position, in order to permit the condensed oil and inflammable liquids to flow along it, and from the lowest point of this pipe another proceeds which conveys them to a proper receptacle.

The pores of the coke are gradually filled up with carbon deposited by the oil; it then ceases to perform its part in decomposition. It therefore becomes necessary to withdraw and replace the coke about once a fortnight. In opening the retort certain simple precautions are necessary to prevent the formation of an explosive compound, which might burst the retort.

It is not necessary that the oil whence gas is prepared should be of the quality which is required to give an agreeable light in a common lamp. Common whale, or even fish oil, and the unpurified oils of vegetables give a gas as good as that obtained from winter strained spermaceti. Its cost is therefore by no means as great as might be imagined. In this country in particular it might be applied to bring into use an article which is now generally permitted to be wasted, namely the seed of the cotton; and it is said that an attempt is now making in New-Orleans to light that city by gas from this material. The seed might also be used for this purpose without having undergone the operation of expressing the oil from it.

An apparatus for the manufacture of oil gas is represented. Fig. 3.

A. Furnace;
B. Retort, filled with coke;
C. Reservoir of oil;
D. Chimney;
E. Cistern of the gasometer, represented as built of brick;
F. Gasometer;
G. Hollow pillar in which the counterpoise of the gasometer moves;
h, Pipe which carries the gas in such manner as to cause it to pass through the oil;
i, Pipe which admits oil into the retort.
k, *k*, *k*, Pipe which conveys the gas to the gasholder;
l, *l*, Inclined pipe to carry off the condensed vapors;
M. Cistern in which the condensed matter is collected;
n, Main distributing pipe;
o, Counterpoise.

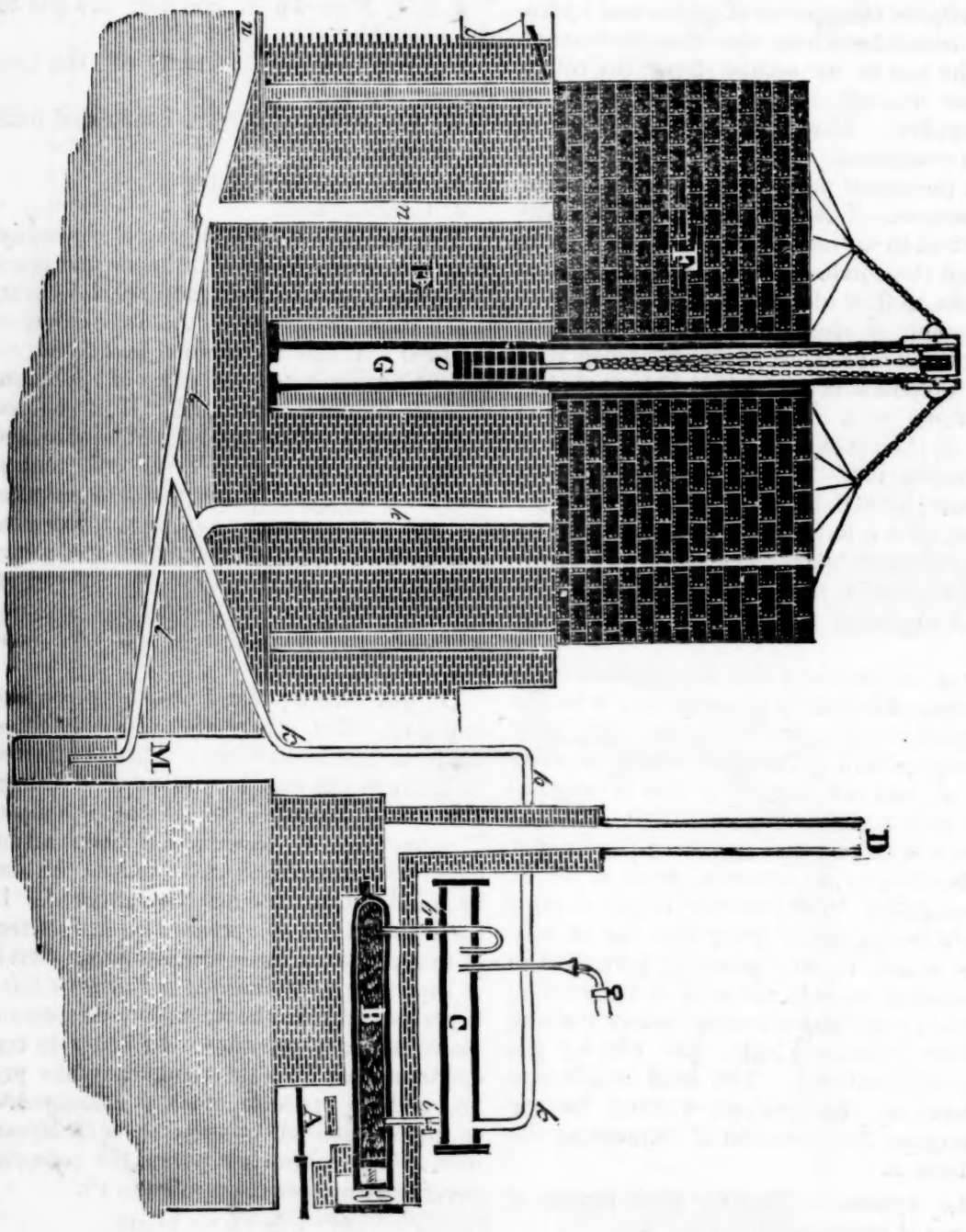
The manufacture of oil gas is obviously much more simple both in theory and practice than from coal. It requires, however, much more attention to the regulation of the heat. If this be too low, less of the oil will be decomposed, and more of the condensible liquids generated. If it be too high, the gas will indeed be much increased in quantity, for at a high red heat it may be nearly doubled by the conversion of olefiant gas into hydrogen, but it will give less light than the less bulk of gas generated at the lower temperature. We shall examine this question further in speaking of the comparative value of oil and coal gas.

Oil gas may be distributed by pipes like coal gas. But it is more peculiarly fitted for being made portable. This is effected by forcing the gas, by means of a pump, into strong vessels of sheet iron or copper. The best form for these is a cylinder terminated by hemispheric ends; unless the size be small, when they may be spherical. In these the gas is compressed to the extent of thirty or even forty atmospheres; that is to say, the gas contained is thirty or forty times as much as the vessel would contain under ordinary pressure. In order to render them safe from accident, they are proved under a pressure of sixty atmospheres or nine hundred pounds to each square inch. The pump by which the compression is effected is represented. Pl.

(c) GAS FROM ROSIN.

Rosin may be decomposed and made to furnish a gas equal in quality to that from oil. The best method for this purpose is the invention of Professor Daniell of London. The Rosin is dissolved by heat in spirits of turpentine, and the solution treated in the same manner as oil. To obtain gas of the best quality, however, it seems to be necessary to attend even more particularly to the regulation of the heat than in the use of oil. At too low a heat, the vapor of the spirits of turpentine passes over, and will

Fig. 3.



cause the gas to burn with smoke. At too high a heat, a larger quantity of elastic fluid will indeed be generated, but in spite of this increase it will give less light.—For a long time gas from rosin was used as portable gas, in London, and was found to answer the purpose as well as tha prepared from oil. In experiments at which the writer assisted, made at the New-York gas works, rosin gas was found to give as bright a flame, and as much light from the burning of a given bulk, as oil gas. It does not appear however, that the gas usually furnished by that establishment is of as good quality as that which was the subject of experiment.

(d.) COMPARISON OF THE VALUE AND ILLUMINATING POWERS OF GASES FROM THE SEVERAL MATERIALS.

AUTHORITY—CHRISTISON and TURNER. Edinburgh Philosophical Journal No. XXV.

The illuminating power of a gas will depend upon the proportion in which the several compounds of Hydrogen and Car-

bon, and uncombined Hydrogen are mixed in it. Of the gaseous compounds of those two elements olefiant gas has the greatest density, and the vapors of the two liquid compounds are even heavier than it. As the flame of these three compounds is more brilliant than that of carburetted hydrogen, and as uncombined hydrogen which gives but little light, has has no more than an $\frac{1}{8}$th of the density even of light carburetted hydrogen, it will be obvious that the denser the gas the higher its illuminating power. This power however, does not increase exactly as the density, but to all appearance in a higher ratio. The densities of gas from different substances and prepared in different ways, is given beneath, in terms of hydrogen as the unit.

Coal Gas from the London works used by Mr. Dewey in his experiments,	2.10
Coal Gas from Westminister used by Brande,	6.64
Coal Gas of Edinburgh and Glasgow—mean,	9.00
Oil Gas of Taylor and Martineau,	13.54
Do. best,	14.49
Oil Gas of the worst quality made in England,	9.90
Coal Gas of Perth,	10.50
Oil Gas made in France,	6.98
Oil Gas made from Whale oil in Edinburgh,	15.75
Gas from cannel coal within the the first hour of distillation,	9.75
After ten hours,	5.17

The last named gas, which has the least density of all, contains—

Olefiant Gas and vapor	0
Light Carburetted hydrogen,	20
Hydrogen,	60
Other Gases,	20
	100

That obtained during the first hour, and having the density of 9.75, contains

Olefiant Gas and vapors,	13
Light Carburetted hydrogen	$82\frac{1}{2}$
Hydrogen,	0
Other Gases	4
	100

The French oil gas of the density of 6.96 consists of—

Olefiant Gas and vapors,	6
Light Carburetted hydrogen,	28
Hydrogen,	45
Other Gases	21
	100

The Oil Gas of Taylor and Martineau whose density is 13.54 contains—

Olefiant Gas and vapor,	38
Light Carburetted hydrogen,	46.5
Hydrogen,	3
Other Gases,	12.5
	100

The oil gas whose density is as high as 15.75 is probably almost wholly composed of olefiant gas and the vapors of the liquid carburets. Its illuminating power is probably even greater than that of pure olefiant gas prepared from alcohol, and bears to that of gas from common coal of the density of 6.10, the ratio of 4:1. The coal gas of Taylor and Martineau has an illuminating power bearing to that of the average gas from cannel coal of the density of 9, the proportion of 2:1. But as the manufacture of oil gas is attended with more difficulty than that from coal, it does not appear that when good cannel coal can be procured, it will be safe to count upon a greater superiority on the part of oil gas than 3 to 2. This rule may at any rate be considered to apply almost with certainty to gas from rosin, whose manufacture is even more precarious than that of oil gas. If however the oil-gas is of good quality and the coal gas of the worst the relation is as 3 to 1.

In burning gas it will be observed that the flame is of a pale blue color near the orifice, then becomes white and brilliant, while towards the summit it again becomes pale. According to the rationale already explained this is readily accounted for. At the orifice, the burning of a part of the gas and vapor causes the deposite of carbon, which disseminated through the next part of the flame, gives it brilliancy; but as the carbon burns itself, it is exhausted before the summit is reached and the flame again loses its brightness. If however, the carbon be not wholly consumed it will make its appearance in the form of smoke, and we hence infer that the flame will reach its maximum of brilliany, jnst before it begins to emit smoke. It might however, be a question, whether the expenditure of gas will not equal or more than counterbalance

the increase of light. This is a question which can only be settled by experiment, and we shall therefore, quote those of Christison and Turner.

In a flame from a single jet, fed by coal gas the following were the results:

Length of flame,	2 in.	3 in.	4 in.	5 in.	6 in.
Light	55 6	100	150.6	197.8	247.4
Expense of gas	60.5	101.4	126.3	143.7	182.2
Light from a given quantity of gas.	100	109.	131.	150.	150.

It will therefore appear, that by increasing the flame from two to four inches the light is increased from 55.6 to 197.8, or between three and four times; and that with the long flame one half more light will be given with an equal expense of gas than by the short flame.

With oil gas from a single jet the results were

Lenght of flame	1 in	2 in.	3in.	4 in.	5 in.
Light	22	63.7	96.5	141	178
Expense of gas	33	78.5	90	118	153
Light from equal quantities of gas	100	122	159	181	174

A village carpenter at Ballindine is busily engaged upon the construction of a carriage to be propelled by *air!* and which he expects to complete in a month.—(Limerick Chronicle.)

A very important improvement has been made in the silk loom, which is likely to operate favorably upon the manufacture of this valuable article of trade, and may be the means of transferring a very large portion of it from France and Italy to this country. It is now perfectly clear that steam-power may be applied with the greatest advantage to the silk loom, which has heretofore been worked by hand only; and a young girl may weave, with this improvement, as much silk in a day as by two men upon the present plan. The new loom occupies little more than half the space required by the one in common use.—Manches. Herald.

A mechanician of Paris has lately invented a machine, which he calls *voiture moulin*, destined to follow armies, and grind and bolt all kinds of corn. It is with two wheels, one horse, and is driven by a man who sits like a coachman, and can stop the mechanism at pleasure. The impelling force is the movement of the wheels. When it stops, however, it may be worked by the hand or by water. In action the whole day, it can grind two hectolitres and a half, with one man; five with two; and nine with a horse.

There are at present in action at Saint Quentin 36 steam engines, of which the aggregate force amounts to 374 horse-power. The statistical Report of the Administration of the Bridges and Roads shows, that in the Department of the Aisne, the number of steam engines was 29 in 1833, 40 at the end of 1834, and now Saint Quentin alone contains 36, without reckoning those which are used for the purpose of heating houses and other buildings.—There are several new engines now in construction.

Iron Steamboats.—Increased facility in the extension and application of steam navigation is expected to rise from the substitution of iron for wood, in the construction of vessels. Hitherto iron steamers have been chiefly confined to river navigation; but there appears no sufficient reason why their use should be thus limited. For sea voyages they offer many advantages; they are not half the weight of vessels of equal tonnage constructed of wood; and consequently, with the same tonnage they will have less draught of water, and therefore less resistance to the propelling power, or, with the same draught of water, and the same resistance, they will carry a proportionally heavier cargo. The nature of their material renders them more stiff and unyielding than timber: and they do not suffer that effect which is called hogging, which arises from a slight alteration which takes place in the figure of a timber vessel in rolling, accompanied by an alternate opening and closing of the seams.

Iron vessels have the further advantage of being more proof against tracture upon rocks. If an iron vessel strike, she will either merely receive a ding, or be pierced by a hole equal in its size to the point of rock which she encounters.

PAPER READ BEFORE THE MECHANICS' INSTITUTE, JUNE 2D, 1836, ON THE ORDER OF THE CREATION. BY OLIVER SMITH, MEMBER OF THE INSTITUTE.

Let us go back in the history of the earth as far as we can; and how far will this be? Can we pursue this retrogade course any further than the sacred historian has done, when he says, that, "In the beginning God created the Heavens and the earth"? To this question we shall endeavor to give an answer; and that answer will be in the negative; though in coming to this conclusion we shall adopt a course that may be thought perhaps, to be a little circuitous. And first, we would make the remark, that it is no where directly asserted in the sacred volume, that there is a God, or Great First Cause of all other things; but that is always assumed there, as indisputably granted. To say that the material universe around us arose and continues by chance, would be what the sacred penmen seem not to have expected to hear from any rational and sober man; and they appear to have made no provisions to meet one that would do so. In fact we may safely say, I think, that no one in the full exercise of reason, ever seriously believed this; and but few, comparatively speaking, have ever been reckless enough to assert it. And should it be contended that, although there may be a God, a Great First Cause, who has moulded matter into the present order of things, still matter itself is eternal, we might reply that if matter is eternal or coeval with the Deity, it must either constitute a part of this being or be independent of him. And if it exists independently of him, how does he control it as he plases, as we all profess to believe that he does? And again it may be asked how does he know exactly what it is, and how to use it, unless he made it? In short, we must believe that there is a God, and that he consists not of matter, nor partly of matter, but of pure intelligence and power, and rectitude, or something which we call spirit, but of which we can form no other idea than that of an assemblage of attributes.where the ones just mentioned are prominent; and that he not only gave to the material universe its present structure, and sustains it as it is; but actually made or originated the materials of which he formed it. And if there are difficulties in this supposition, there are still greater ones to embarrass any other we can make upon the subject. We are none of us prepared to say there is no God; nor that matter exists independently of God; nor that it constitutes a part of his being.—What then can we do in this case but to adopt the simple language we have already quoted above, that, "In the beginning God created the Heavens and the earth"?

We can make suppositions with regard to the steps which the Creator adopted to accomplish this work, but they will be mere suppositions; and yet they may aid us to perceive how little we know with any degree of certainty, upon the subject before us. Let us then suppose that, among all the material bodies in the whole wide regions of space, the Sun was the first that was brought into being, and endowed with the property of attraction, and located, no matter where. As there was no body to attract it from its place, it must have remained there as long as the power that left it permitted it to do so. Next we suppose, that some one of the planets was formed, and being so formed, and endowed with the property of attracting other bodies, and of being attracted by them, it must have been immediately set to revolving around the sun; for otherwise, it would rush directly to it, and become united with it. Thus we can suppose that the whole solar system was brought into being and put in motion.

Now let us suppose that Sirius, the brightest star in the heavens, and for that reason conjectured to be the nearest, was located in the same relative position which it now occupies with regard to the sun; and made to revolve around the common center of gravity, betwixt its self and the solar system; while this system was made to revolve around the same center. In this way the bodies in question might be made to preserve the same distance from each other. And more too, a full system of bodies might be made to revolve about Sirius constituting a Sirian system.

Next we can suppose that Arcturus, apparently the largest, while Sirius is the brightest star in the heavens, was formed; and a system of bodies made to revolve around it; and this Arcturian system made to revolve around the common center of gravity betwixt itself and the solar and Sirius of which we have spoken; while these latter were revolving around the same center; and all this before the bodies in question had time to rush together; and thus, all three of these systems might be made to preserve the same distance each from the others; and so on indefinitely. From this it appears that the heavenly bodies may be kept in their *relative* positions, although creation is not interminable; but in order to preserve them in their *absolute* positions, it is necessary that they should be placed at proper distances throughout immensity; for the exterior ones, and such of course, their will be, unless they are infinitely extended, will tend toward the interior ones; and in order

to prevent them from rushing together, they must be made to revolve about each other. But as their natural attractions will be inversely as their distances apart, the motion in question must be very small in the systems around us, as the space between them is inconceivably great. Such a motion is suspected, but not yet positively proved, in the solar system; and till it is proved, we must suppose that creation is boundless as infinite space; for otherwise we cannot account for the equlibrity, which is doubtless no less real than apparent in the heavenly bodies. It is true that some of the stars have a motion, but this does not appear to be the one to which we have now reference; and if no such motion exists in the bodies above us, then no part of creation could have existed before the other; but the whole must have been thrown into being throughout immensity, at the same moment of time. So that it might well be said that "God spoke and it was done; he commanded, and it stood fast." We can suppose, and perhaps the supposition may aid our weak conceptions, that matter in its incipient state, was not endowed with the property of attraction. And in fact, from the representations that are given us of what the important telescopes of the present day are bringing to view in the regions above us. We have perhaps, some ground to supect there are masses of matter around us that are not formed into regular bodies, nor subjected to the laws of gravitation.—The Great Dr. Good, in that immortal work, his Book of Nature, more than intimates, as I understand him, that in his opinion, this is very possible. However, it must be admitted that all this is little better than mere conjecture.

As to the earth, or any one of the planets, as soon as it became endowed with the property of attraction, whether at the moment of its formation or subsequently, it must have been set in motion around some centre of attraction; and this motion, not affecting the senses of those who may happen to be upon the body thus moved, may be called its stability; and this is obviously all the sacred writers mean when they speak of the foundations of the earth. To common observation, the earth appears indeed to stand "fast."

We cannot go back in the history of the earth, then, beyond the period when it began to revolve around the sun, as it now does. It is true we can make suppositions—wa can suppose it to have been made up in part or in the whole from the ruins of some other body or bodies; but this we are not likely to prove very soon; and even if we could do so, the result might not carry us very far into the history of those ruins.

About fifty bodies are found in the earth that are called simple ones; and they are thus denominated, not so much because they are believed to be absolutely so, as because chemists have not succeeded in their endeavors to decompose them. In fact they are all known to contain more or less of light, caloric, and electricity, and some of them magnetism; and if these latter are material substances, or modifications of any material substances, as they are supposed to be, then the bodies in question cannot be simple ones. From these, however, whether simple or compound, it is that all others with which we are acquainted are composed.

Now if we go back and suppose a time when these simple bodies were all put together, we shall gain but little in any respect; for they must, as a consequence of their mutual attractions, have assumed the same globular form that now characterises the earth and the other planets; and they must have commenced immediately to tend toward the sun, either by revolving around it, or by going directly to it; according as they received the proper impulse, or none at all; and furthermore, a chemical action must have taken place immediately among them, producing compound bodies similar to what we now find in the earth.

The first we can reasonably suppose of the earth then is, when it began to revolve about the sun, consisting as it now does of various compound and heterogenous materials. But we can reasonably suppose it contained caloric enough to render it fluid; so that it may well be said to have been "without the proper form" for animal or vegetable life; and to be, consequently, totally "void" of both; while "darkness," or confusion and disorder, so far as either of these kinds of life are concerned, "was upon the face of the deep," or upon the whole map of melted matter of which the earth consisted.

Now let us suppose what must have been true, that this caloric began to radiate to the vacant regions around us, till the surface of the earth became so far cooled, that a thin crust was formed around it. Meantime, the internal caloric was raging and caused a commotion that broke up this crust more or less in different places. Again the surface continues to cool, and another crust is formed including the ruins of the first, and consequently twice as thick as that was. This again is broken up in the same way, and a third one is formed including the fragments of both the others, and

consequently three times as thick as the first one; and so on down to the present time. And something of this kind we actually see going on at this very day. Volcanoes and earthquakes, the first being obviously, and the other very probably, the effects of internal fires, are breaking up the crust of the earth more or less in different places. A large tract of country in Sweden is now actually rising; and other regions in Italy have risen and fallen, and risen again within a few hundred years past; and much the same may be said of many places in South America. In this way we may account for the irregularities in the surface of the earth.

We can make other suppositions, to be sure. We can suppose that the earth was thrown from the sun and the moon from the earth; and we can further suppose that other bodies have been ejected from the earth, and fallen back upon it again; and this will aid us to an explanation of the great confusion which appears occasionally among the rocks and stratums that present themselves in the crust of the earth; and it is possible that the whole or a part of this did actually occur. But the simple formation and breaking up of these successive crusts, in the manner above suggested, will go far to explain all this confusion.

Now let us suppose that the surface of the earth is cooled down to about 85 or something less of Centigrade, or, what is the same thing, to about 150 or 100 of Fahrenheit; so that the water which may have been previously formed by the union of the oxygen and hydrogen that were found among the materials of the earth; and which, if thus formed, must have existed around the earth in a state of steam, is settled down upon the irregular surface, and begins to form oceans, seas, lakes and rivers there, according to what the historian has told us. The oxygen and nitrogen, which happen to be at liberty, arise, in consequence of their specific levity, and form an atmosphere around the earth; and the water that condenses upon it, is separated from the vapors that still remain above it; and as this water runs into the cavities as above suggested, the dry land "is made to appear."

Now we know that animalcules will make their appearance in warm water that is allowed to remain stagnant for some time.—They are called infusiora, because they are more apt to appear in such water when it contains an infusion of animal or vegetable matter; and perhaps they are not found in any water at this day, except such matter is present. As these animalcules, though being ranked as they are with animals, they are presumed to be organised, yet exhibit no proper organization, but simply spontaneous motion, we shall call them chaotics, in contradistinction to the higher grades of animals, which, exhibiting, as they do, more or less of organisation, we shall call the organics. And of these chaotics we find two groups; the first of which, being homogeuous, we call the homogens; while the second, having appendages about them, which however are not arranged in any order, call the appendiculates.

We have now spoken of the lowest of the animal kingdom, of nature's first effort from mere dead matter to animalisation; and similar remarks may be made respecting her first step toward vegetation. This step appears in the Fungals Algas and Lichens, some of which are but one short remove, to appearance from mere inert matter; while in common with animals, some of them contain nitrogen; and some even exhibit a contractile motion. They have no distinct axis of growth, nor any distinct circulation of fluids, nor do they bear either leaves, that may be properly so called, or flowers; nor do they produce their seeds in that obvious manner in which the higher grades of plants do; and hence they are called Cryptogrames, a term that implies having a concealed mode of furetification. These were undoubtedly the first plants, and the chaotics the first animals, that appeared upon the earth.

We now rise to a higher grade of animals, which we call the Organies, or those that are obviously organised; and the lowest groupe of these, and the first we shall speak of now, are the Zoophites, or the animals that resemble plants. They unite together and form compound masses, and partake of a common life, so that what one of them eats goes to nourish all the rest. They have no head, though some of them have a buccal opening, and this is sometimes surrounded by tentacles. And let us bear in mind we have not yet ascended to the animated animals, or to those whose parts are arranged along a common axis, and much less to the cephalic or headed ones; but all these lower grades are headless; and their parts radiate more or less from a common centre. The same opening answers for the mouth and the arms; and they exhibit nothing like a circulating system, and but little of a nervous one; and this nervous system, when discoverable at all, consists in these lower grades only of medullary matter in different parts of the body. The animals in question subsist undoubtedly upon the chaotics, which they probably seize by means of their nu-

merous tentacles. We divide them into two groups: the Coralifers, or coral bearers or producers, and the Zoanthids, or the animals that resemble flowers; and these we shall call Clessis. The Coralifers catch the lime and other matters that are found in the ocean, and with these they construct their habitations, some of which are mossy, as the sponge—some woody, as a few of the Tubularies—and some horny, as several of the Gorgons; but the most of them are calcareous and stoney, and consist of the coral reefs and submarine mountains that are found in the seas of warm climates. Some of these animals. and especially those that inhabit the sponge, are too minute to be seen. And here I would observe, in passing, that I think this to be the proper class for the Encimates, or lilly-shaped animals, which have been differently arranged by different Zoologists.

The Zoanthids we intend shall include those Zoophites only, which do not construct any habitation at all, being entirely naked. Some of them float in the ocean, while the rest affix themselves to some other body; but these have the power of removing at pleasure. A part of them are fleshy, and the rest gelatinous; and hence we can make two groups or orders of them; and their tentacles, whether expanded or closed, resemble flowers in the same state, and hence their name. The most prominent among them are the Actinias, or sea anemones. These added to the Chaotics will make three classes.

From the Zoophites we rise to the Zoaides, a term we adopt in contradistinction to Zoophite, and which implies proper animals; and the first group we come to here, are the Medusas which we shall call a class. Their form is discate, and their substance gelatinous, and they float in the ocean and shine in the night; and have tenacles which extend down into the water from the under side of their disc.

(To be Dontinued.)

From the Repertory of Inventions.

ON THE THEORY OF GRADIENTS ON RAILWAYS. BY W. S. B. WOOLHOUSE. —Mr. Woolhouse has addressed the following letter, dated February 20, 1836, to the Editors of the London and Edinburgh Philosophical Magazine, in reference to the papers of Dr. Lardner and Mr. Peter Barlow, which we transferred, from that work, to the "Progress of Science" in our number for March last.

As Dr. Lardner and Mr. Barlow hold out conflicting opinions on the theory of gradients on railways, and have left the subject in a state more calculated to create doubts in the minds of the less informed of your readers than to lead them towards the formation of settled conclusions, perhaps you will favor me with the insertion of a few words, by way of explanation, as far as the philosophy of the question presents itself to my mind. Mr. Barlow, without absolutely saying which of the two solutions is wrong, though probably quite conclusive in his own view of the matter, first states his objection to the arithmetical results of the formula employed by Dr. Lardner for the velocity, in certain cases, then gives an outline of his principle of investigation, and finally expresses himself "quite content to leave the decision to those whose minds have not already received a bias from preconceived notions of the forces." Whatever sentiments may prevail as to the competency of my opinions on such a subject, it will at least be acknowledged that I possess the qualification of being free from the bias here alluded to, and I am induced to hope that your readers will, on this very ground acquit me of any imaginable interference in this undertaking, voluntarily, the examination of a point that has already had the attention of such distinguished individuals. By close and continued application of particular opinions to particular subjects, it is indeed surprising how they fix themselves in the mind, and become ultimately, whether true or false, of almost a fundamental character. But I do not consider this observation to be applicable to the present case. It is my wish to simplify and expose the truth as far as I can perceive it. I do not, however, intrude the present remarks in elucidation of the subject without some degree of hesitation, although quite free from apprehension as to their theoretical soundness. To many of your readers, who must be far from satisfied with the present situation of the question, I neverthe less feel myself justified in submitting them.

According to Dr. Lardner, the subject is "totally distinct from the consideration of accelerating forces;" he considers it to be essential that the velocities be continued uniform, and therefore discards every thing in the shape of an accelerating force.—Now, in order that such a theory may be

sustained, it is a well known elementary principle of forces, that the power employed must be always precisely equal to the resistance, or the amount of friction combined with the proper resolved effect of gravity along the railway, observing, however, that in the term friction, we must include the resistance to the motion experienced by the carriages, &c., in passing through the atmosphere. We shall not here discuss the practicability of preserving this exact balance between the forces at the various changes of inclination; nor shall we offer any serious objection to the principle that the friction is the same for all velocities, which has received the sanction of general practice, though doubtless inaccurate, as far as regards the effect of the atmosphere.

Contiuuing the notation of the preceding letters, we have t, for the moviug power that will keep the load moving at a uniform speed, V, along the level plane; $t + \sin \varepsilon$ for the moving power to keep the load moving at the same uniform speed up the inclined plane: and t—sin ε for the moving power to sustain the same uniform speed down the inclined plane. To the truth of this there cannot be any doubt, if we assume, as Dr. Lardner has done, that the friction t is not altered by the slight inclination of the plane. By following Dr. Lardner's reasoning, we are hence fairly led to the result that the same amount of mechanical force will be expended in ascending and descending the inclined plane, as in drawing the same load backwards and forwards along the level plane of the same length L.

Though Dr. Lardner is certainly justified in stating this conclusion to be a plain result of first principles, it should, at the same time, be remembered, that it rests solely on the hypothesis that the power in each case is to be precisely adapted to the amount of resistance, so as to preserve throughout the same uniform velocity V.—This hypothesis has not been admitted by Mr. Barlow, and it must necessarily fail in determining the effect produced by the deflection of a rail during the transitory passage of the carriages. In this way, it appears to me that the principle advocated by Dr. Lardner, carries with it a restriction that entirely unfits it for an objection to what has been advanced by Mr. Barlow, in his second Report, addressed to the Directors of the London and Birmingham Railway Company. On the other hand, "however, I can only come to Mr. Barlow's conclusion, that it is altogether erroneous, both in theory and practice," when the assumed maintenance of uniform motion is objectionable, as it most certainly is, in the case of the deflections of rails. Contenting myself at present then, with the opinion that the contending parties thus view the question of power expended, on different suppositions as to the way in which it is applied, I shall just take a very brief sketch of the question of velocity, when the motion is not assumed to continue the same through planes of different inclination.

Dr. Lardner supposes that in cases of uniform velocity, the resistance into the velocity is constant, and on this assumptiun deduces the equations stated by Mr. Barlow in (Repertory, March 1836) page 181, viz:

$$(t - \sin \varepsilon)\, v = t\, \mathrm{V} \quad v = \frac{t\, \mathrm{V}}{t - \sin \varepsilon}$$

This assumed principle is, in my opinion, decidedly inaccurate, more especially, when it is contemplated that the carriages will pass along with the uniform velocity so expressed. For uniform motion can only be continued when the moving force continues equal to the resintance; and assuming with Dr. Lardner, that the amount of friction is independent of the velocity, the speed will in such a case be quite indeterminate, or, in other words, the power so applied will sustain uniformly, *any velocity* that may have been previously communicated. If the friction were *really* independent of the velocity, while a moving force which exactly balances the resistance would maintain uniformly *any previously imparted motion*, a moving force which exceeded the resistance would transmit the carriages with a velocity continually accelerated, in conformity with what has been said by Mr. Barlow: but as the portion of resistance arising from the atmosphere at least increases with the velocity, it is evident that the resistance will gradually augment till it balances the moving force, and so a uniform motion will eventually succeed. If the carriages be so acted upon as to retain a uniform velocity v along a level plane, and with such velocity and moving power they arrive at the upper end of, and proceed down, an inclined plane, the investigation given by

Mr. Barlow (London and Edinb. Phil. Mag. vol. viii), pages 98—100, will be strictly accurate on two suppositions, viz., 1, That the friction is independent of the velocity and inclination of the plane. 2. That the action of the moving power is not diminished by the increase of velocity.—The former supposition is sanctioned by Dr. Lardner; the latter, as Mr. Barlow justly observes, if not true, will have the effect of giving the velocity and space passed over, rather in excess of the truth, and therefore the more favorable for a comparison with Dr. Lardner's velocities, which are so much in excess. There can be no doubt as to the inaccuracy of the preceding formula, from which the last mentioned velocities are calculated, as the principle from which it is derived is not founded in theory.

Analysis of Raw Silk. By Mr. J. W. Laidlay.—A. A hundred grains of yellow raw silk were digested in moderately strong alcohol, which soon assumed a fine orange tint. At the end of some days, much color remaining unremoved, heat was applied, and the solution boiled. The alcohol was then decanted, and successive portions of the same solvent were employed, till the silk appeared perfectly decolorized [decolourated]. The solutions were then reduced to a moderate compass by distillation, and on cooling, deposited a feeble, cloudy precipitate, which subsided slowly. The clear fluid being decanted, and evaporated at a gentle heat, to dryness, left a deep orange brown mass which weighed 0.9 grains. This substance was adhesive, fusible, scarcely, if at all, soluble in water, but readily so in alcohol, to which, in small proportions, it communicated a fine orange tint. A concentrated solution deposits on cooling a vast number of minute shining crystals, which subside to the bottom in the form of a brilliant orange-brown powder. When this precipitation has ceased, the solution lets fall, by spontaneous evaporation, a few filamentous bunches of a white color, and apparently fatty nature; but in quantity too small for more particular examination.

B. The flocculent precipitae above mentioned, being collected and dried weighed, 0.1. It had the consistency, fusibility, and other sensible properties of wax.

C. The silk, still perfectly elastic, was now transferred to a deep silver vessel, and boiled with successive portions of distilled water as long as any sensible action was produced. A colorless, opalescent solution was obtained. It was frothy and viscid; and exhibited scarce any tendency to deposit the particles it held in suspension. A solution of bi-chloride of mercury, cautiously dropped from a graduated tube, threw down a bulky coagulum, which, after boiling, became much condensed, and permitted the easy decantation of the clear fluid. This precipitate, well washed, and dried, weighed, (deducting 1.4 grains, the amount of metallic salt employed) 8.9 grains. It had all the well known characteristics of albumen.

D. The clear fluid decanted in process C, being evaporated to dryness in a steam-bath left a nearly colorless, transparent, brittle mass, resembling gum. It weighed 13.0 grains, and had a tendency to soften, from the presence of a small quantity of deliquescent salts. It dissolved readily in water, from which neither the bi-chloride nor tan threw it down. It exhibited no tendency to gelatinize, however concentrated; and was copiously precipitated by sub-acetate of lead.

E. Alcohol now took but a feeble tinge from the silk, which still retained a little harshness. A very dilute solution of caustic potash was accordingly exhibited; and after a few hours digestion, was poured off, exactly neutralized with muriatic acid, and treated with the bi-chloride as in process C. The precipitate of albumen thus obtained weighed 0.4 grains.

F. Finally, the silky fibre, which had now attained its full lustre and flexibility, weighed 76.5; exhibiting a loss of 0.6 upon the total, attributable to hygrometric moisture; the whole of the products being dried at a steam heat immediately before weighment. The following are the results of the analysis:

A. Resinous coloring matter, and white filamentous substance,	0.9
B. Wax,	0.1
C. and E. albumen,	8.9
D. Mucus,	13.0
E. Bleached fibre,	76.5
F. Hygrometric moisture,	0.6
Grains,	100.0

An analysis of white silk gave identical products; and in amount differing only fractionally from the above; except in the particular of the resinous coloring matter, which was indeed present, but in a very much smaller proportion. It is probable that the varieties of color observable in cocoons, the yellow, the orange, the buff, the white, and the greenish hues, depend only upon the greater or less amount of this resin in the fibre.—[Journal of the Asiatic Society of Bengal, vol. iv., p. 710.

A. T.

From the Repertory of Patent Inventions.

ON THE SOURCES AND COMPOSITION OF THE DIFFERENT KINDS OF GAMBOGE. BY DR. CHRISTISON; AND ON THE BOTANICAL ORIGIN OF GAMBOGE. BY DR. GRAHAM.

The papers of which the official abrtracts are subjoined, were lately read before the Royal Society of Edingburgh.

Gamboge was first made known by Clusius about the commencement of the seventeenth century, as a concrete juice from China. About the middle of the same century. Bontius conceived he had traced it to a particular species of *Euphorbia*, growing in Java and in Siam; from the latter of which countries the whole gamboge of commerce was at that time obtained. About the close of that century Hermann announced that gamboge was produced by two species of trees growing in Ceylon, which have been since often confounded together, but which are now designated by the names, *Garcinia Gambogia*, and *Stalagmitis gambogioides*. About the middle of last centry, gamboge was referred Linnæus to the former of these plants, and his reference was generally admitted; but about thirty years later, Professor Murray of Gottingen conceived he had traced it satisfactorily from the specimens collected by Koenig in Ceylon, and information obtained by the same botanists in Siam, to a new species which he called *Stalagmitis gambogioides*.

Dr. Graham shows, from specimens and drawings sent from Ceylon, both by Mrs. Colonel Walker to himself, and by David Anderson Blair, Esq. to the late Dr. Duncan, that the plant producing Ceylon gamboge is neither *Garcinia gambogia*, as Linnæus thought, nor *Xanthochymus ovalifolius*, as conjectured by Dr. Wight and Mr. Arnott, nor *Stalagmitis gambogioides*, according to Murray and Koenig, but is a species described by Lamarck and Gartner under the name of *Garcinia* or *Mangostana morella*, although it differs from all of these genera in the structure of its stamens, and, therefore, probably ought to be considered a new genus among those producing a gambogioid juice.

Dr. Christison proved, that, at the present time, Ceylon gamboge is not an article of European commerce, and that the whole gamboge of the markets of this country comes, as in the time of Bontius, from China. After mentioning the analysis of fine gamboge made by Braconnot in France, and John in Prussia, he stated the following as the mean composition of the several varieties of gamboge he has hitherto examined:—

Pipe gamboge of Siam:

Resin	72·2
Arabin	23·0
Moisture	4.8
	100·0

Cake gamboge of Siam:

Resin	64·8
Arabin	20·2
Fecula	5·6
Lignin	5·3
Moisture	4·1
	100·0

Ceylon Gamboge sent by Mrs. Colone Walker:

Resin	70·2
Arabin	19·6
Fibre of wood and bark	5·6
Moisture	4·6

Ceylon gamboge, adhering to a specimen of the bark sent by Mr. David Anderson Blair:

Resin	75·5
Arabin	18·3
Cerasin	0·7
Moisture	4·8
	99·3

The proportion of the gum to the resin varied somewhat in each variety, but never differed more than two per cent. from the means given above.

The author added, that he had found the resin to be the active principle of gamboge.

He inferred from the composition of the different kinds of gamboge, and other circumstances detailed in his paper, that the cake gamboge of Siam is not entirely a natural production, but a manufactured article: that Ceylon gamboge, if freed from incidental fibrous matter, corresponds almost exactly with Siam gamboge: that therefore, they are probably produced by the same plant: that Ceylon gamboge possesses precisely the same medicinal properties; and that this variety, if more carefully collected, may, in all probability, be applied with equal advantage to every economical purpose which is at present served by the finest pipe gamboge of Siam.

A. T.

ON THE MATHEMATICAL FORM OF THE GOTHIC PENDANT. BY PROFESSOR FORBES.

The following is the official abstract of a paper read before the Royal Society of Edinburgh, on the 1st of February last, as given in the "Proceedings" of that learned body.

The author commenced by stating the general proofs of the knowledge of the principles of equilibrium displayed by Gothic architects in the structures (especially) of the Pointed style. The adaptation of their edifices was to the combined ends of elegance and strength. The extension of this principle to the case of the Gothic pendant is the chief object of this paper. Sufficiency in point of strength, without redundancy of material, is considered by the author as the primary source of architectural beauty, which he has demonstrated to be the case when the depending Gothic drop is generated by the revolution of the logarithmic curve round its axis. The condition of maintenance of a depending body, is, that the increment of the section may be in a constant ratio to the increment of weight of the body to be sustained. This is shown to be attained in the case of bare support, when the modulus of the logarithmic curve is equal to twice the modulus of cohesion of the substance of which the pendant is composed, in feet. Under these circumstances, the depending mass would be just within the limit of disruption, but its strength would be uniform throughout, and the tendency to separation would at no one point be greater than at another. It is not imagined that the Gothic architects could have had a mathematical knowledge of a curve, which was not attained till long after, but the degree of *tact*, by which the eye is guided in the selection and adaption of symmetricel forms, seems quite capable of explaining such an approximation to theory, which, it is believed, has not been before noticed. Thus, a depending cylinder appears overloaded at its inferior extremity, a cone towards its middle, and so of all figures which are not concave outwardly.

RAISING THE STATUE OF NAPOLEON.—At a meeting of the Institute of British Architects, held on the 3rd of June, Mr. T. L. Donaldson, Honorary Secretary, explained the means lately employed for placing the statue of Napoleon upon the Colonne Vendome, Paris. This operation was one of considerable difficulty. It is true that, as a statue had previously been placed on this column, and had been removed, M. Lepere, the architect charged with the task of erecting the present statue, had precedents to resort to; but, unfortunately, they were such as were of no use to him. When the first statue was placed in its elevated situation, the workmen availed themselves of the scaffolding already fixed firmly in the ground for erecting the column, and, of course, found scarcely any difficulty; and the apparatus which was used for taking down the statue was inapplicable to the raising another in its place. M. Lepere was therefore obliged to contrive a plan for himself, which he adopted with great success, and which has the rare merit of being extremely simple, at the same time that it displays an admirable combination of theoretical knowledge with practical ex perience.

This plan consisted of a scaffolding, on which was placed the crab destined to raise the statue, and which had for its basis the front wall of the column, and for its point of resistance the whole weight of the cupola, which was nearly 27,000 kilogrammes. The weight of the statue, crab, cable, &c., was about 7000 kilogrammes; so that an immense power was given to the long arm of the lever. The details could not be understood without cuts, but we

shall probably give them, with these, in a future number.

The statue, which was modelled by M. Seure, sculptor, was cast at Roule, by M. Crozatier. The height is 11 feet French (about twelve feet English) from the top of the hat to the plinth, and the plinth is nine inches, French, more. The statue is fixed on the column by strong iron pins, which are soldered deeply into bronzes, placed for that purpose on the capital of the column.—[Architectural Magazine for July.]

Researches In the Art of Dyeing. By M. Chevreul.

Sixth Division.—Of the mutual actions of stuffs, of neutral compounds not saline with colored re-agents, acids, salifiable bases and salts.

The study of the preceding combinations, formed from species perfectly definite, considered as to their properties and composition, is a suitable preparation for that of a more complex character, of stuffs united to ternary and quaternary compounds, such as indigotine, hematine, carmine, alizarine, aurine, luteoline, yellow and white morines, quercitron, &c., definite compounds, which are the characteristic coloring principles of indigo, log-wood, cochineal, madder, *bois de sable*, dyer's weld, *bois jaune*, quercitron, &c., substances employed in the work-shops. This latter division includes the cases in which stuffs are present with these definite compounds, and at the same time with acids, salifiable bases, and salts.

There are two points of view from which I regard the fixation of the preceding compounds upon stuffs. The first is relative to the weight of stuff, that the same weight, taken for unity, of each species of coloring principle is capable of dyeing; the second is relative to the influence arising from:

1st. The proportion of water by the intervention of which the substances act:

2nd. The respective proportions of these substances:

3rd. The temperature.

4th. The contact of atmospheric oxygen.

The influence of this latter agent is in several cases remarkable, as I shall show in a special memoir upon the subject.

I shall here produce the following as an xeample. The coloring principle that I have named white morine scarcely tinges cotton cloth which has received aluminous and ferruginous mordants; but if it have proper contact with the air, the most intense yellow and brown colors are developed. I say the *proper* contact, for if the time be unduly prolonged, these intense colors will be destroyed. I shall produce many analogous facts, which will show that this operation takes place, when the color developed results from a modification by the air, of a definite coloring compound, of the same order as those of which I have spoken.

Seventh Division.—Of the mutual action of stuffs, acids, salifiable bases, salts, and complex tinctorial matters of organic origin.

After the previous inquiries pursued in the order that I have suggested, we enter at last on more complex cases, in which the subject of investigation is not a definite coloring principle which has been sufficiently studied in the isolated state in which it is obtained by chemical analysis, but a substance containing a coloring principle, combined in indefinite proportion, or simply mixed, not only with several colorless bodies, but even, in many cases, with coloring principles, by which it is more or less modified. The complex coloring matters of organic origin, employed in the work-shops, are the only ones treated of by authors who have written upon the subject of dyeing.

With regard to this art, I have two objects in view:

1st. To explain the phænomena which occur in the operations of dyeing, by investigating their respective causes; these causes will comprehend the determination of the bodies by which the phænomena are presented, and the circumstances under which they are manifested.

2d. To reduce the recipes for dyeing and the processes of the art to their most simple expression.

To attain these objects, we must surmount the difficulties arising from the circumstances that the immediate composition of tinctorial substances is far from being perfectly understood, as I have already stated. Researches of the following kind have appeared to me to be very efficacious:

After examining the effects produced when ligneous stuffs, or those of silk and woollen, are submitted to the action of the

different immediate principles of a complex tinctorial matter, or of extracts which, in the present state of science, present these principles in their greatest degree of purity, I examine the effect produced, when the same stuffs are submitted to the action of the complex tinctorial matters themselves, and I seek the explanation of the phænomena presented by the study of the preceding facts.

Many facts are explained by comparative experiments made on the one hand with immediate principles, and the complex substances whence they proceed; and on the other, with the three sorts of stuffs which are the subjects of the art of dyeing.

For example: indigotine, and the indigos of commerce, studied in this manner with regard to the colors which they give to stuffs, paying attention, 1st to the diversity of these stuffs: 2nd to the diversity of the vats in which the operation of dyeing are performed, present theoretical results of great nicety. Thus we see—

1st. That pure indigotine imparts ths same color to silk, wool, and to ligneou) substances whatever be the intensity of the original color (*couleur fixe'e*); consequently, that indigotine applied in gradually diminishing quantities (*de'gradation*) upon any part of these stuffs, gives a collective result of correct tints.

2nd. That these results are entirely different when the indigo of commerce is employed, instead of pure indigotine. Varying results arise not only from the nature of the stuffs, but from the specific differences of the vats employed; the reason is, that in the vats pure indigotine is accompanied by yellow, red, and fulvous coloring principles, which are in various proportions in respect to each other, and have different aptitudes for fixing upon cotton, silk, and wool. Thus a diminishing quantity (*une de'gradation*) of indigotine, operating upon silk in the blue stone vat, gives the clear tints of a greenish blue, and the obscure ones of a violet blue, whilst the intermediate tints are blue, which is caused by a yellow principle which accompanies indigotine, the influence of which is sensible in proportion to the paleness of the tint.

Experiments instituted in this manner serve—

1st. To verify the immediate analysis of tinctorial substances; as the perfect knowledge of the immediate principles of one of these substances, must explain all the phænomena presented by it in its employment in dyeing.

2nd. To explain why dyers employed in the dyeing of cotton, have often ideas of the nature of a certain coloring matter, very different to those of persons engaged in the dyeing of silk or wool, which is caused by the complex nature of the coloring matter, which imparts but one coloring principle to cotton, whilst it gives two to silk or wool. This explains the reason that calico printers admit the existence only of a red coloring principle in madder, whilst the dyers of silk, and especially of wood, willingly admit that there are three, red, yellow, and fulvous.

My previous experiments upon coloring matters, particularly upon those of logwood, have been of great service to me, when engaged in determining the compounds to which the stuffs dyed with matters of organic origin owe their color. In fact, having long known that salts with insoluble bases, that is, those in use in dyeing, under the name of mordants, for fixing the soluble coloring principles, have, when a solution of them is mixed with a solution of the soluble principles, a tendency to form a precipitate equivalent to the *coloring principle+sub-salt*, and that this precipitate is reduced by sufficient washing to an insoluble compound of *coloring principle, and a base which sometimes performs the function of an acid*, I have been led to inquire whether similar compounds be not formed in the operations of dyeing, either when these organic coloring matters are present with stuffs to which mordants have previously been applied, or when dyed stuffs are submitted to the action of an alkaline solution, as is the practice in dyeing cotton of a Turkish red color. Experiment has confirmed this inference, for I have ascertained that cotton dyed with colors for which alum is employed, if analysed after average do not present any trace of sulphuric acid.

To this I may add, that if two specimens of red cotton *rose'* by a preparation of tin, which have been sent to me with the assurance of their having been alumed, have really undergone this operation, it will follow, that there is an operation in dyeing, in which a base at first fixed to a coloring principle or to a stuff, may be

eliminated by another base which will supply its place, for the two specimens I am treating of, not only do not contain sulphuric acid, but are also devoid, or very nearly devoid, of alumina. This base has been replaced by peroxide of tin.

Finally, these experiments have proved to me: 1st. The influence that matters decidedly alkaline have in accelerating the destruction by atmospheric oxygen of coloring principles of organic origin, soluble in water; 2nd. The acidity of peroxide of tin; 3rd. The tendency of alumina to act as an acid in several combinations, especially in those which it forms with coloring principles; these results appear to me sufficient to explain why these two oxides are so important in dyeing, for fixing combustible coloring matters upon stuffs.

Eighth Division.—Stability of the color of dyed stuffs, considered in relation to heat. light, water, oxygen, the air, boiling water (debouillis), and re-agents.

The researches that I have undertaken with regard to the stability of the coloring matters fized by the dyer upon stuffs, have been pursued in conformity with the views enunciated in my "*Considerations ge'ne'rales sur l'analyse or organique imme'diate.*"—(1824.) I have not, according to the general practice, remained satisfied with observing the alterations experienced by stuffs when they are exposed to the air, but I have also, at the same time, noted the modifications experienced by specimens of the same stuffs when placed in a dry vacuum, in the vapor or pure water, in dry hydrogen gas, in dry air, and in air saturated with the vapor of water. My observations, continued during the course of several years, prove the indefinite nature and even the inaccuracy of the ideas generally received upon the subject; and they furnish an experimental basis for the theory of bleaching by natural agents alone, in which we are absolutely deficient. In short, the conclusion at which I have arrived, agreeably to what I have said in the work already alluded to, is, that the alterations of compounds called organic, that are so often attributed to heat and light, are the result of several causes which act at the same time as those agents. It is my intention shortly to present an especial memoir upon the subject to the Academy.

I have applied myself to the discovery of simple means of recognizing colored matters capable of being fixed upon stuffs, because I thought that if the degree of stability of these matters were once determined, trials might be made which would show the composition of matters fixed upon a stuff; the fact being given, whether the color of the stuff would resist atmospheric agents or not.

Finally. The second part of my course is concluded by an examination of the relations of dyeing to general chemistry and optics.

I venture to hope that the Academy will perceive in the account that I have just sketched of my labors during the ten years that I have been at the Gobelins, the reason of the scarcity of the communications that I have had the honor of submitting to it during that time. Wanting bases, being obliged to establish them myself, and having also to surmount other difficulties of a very different nature, I found it impossible to apply myself to any profound researches, before I had obtained possession, by preliminary and protracted experiments, of the whole of the subject upon which I proposed to treat.

The account which I have just given of the classification of the subjects composing the second part of the course which I deliver at the Gobelins, will enable me to present special memoirs to the Academy, without fearing the reproach of want of co-ordination, because the order of their successive publication may differ widely from that of their arrangement in the work for which they were undertaken.—[Nouvelles Annales du Muse'um D'Histoire Naturelle, tome iv., p. 409, et seq.

Chinese Manufactures.—The superior industry of the Chinese people, as compared with other Asiatic nations, is proved by their extensive exportation of manufactured articles. Besides the more important articles of tea and silk, the following may be added, —alum, white-lead, red-lead, brass-leaf, tutenague or zinc, false-pearls, glass-beads, paper, paper-hangings, toys, table and floor mats, and china-ware, with the precious metals. Alum is prepared in the distant province of Kiang-see, which supplies, we believe, the whole East with this mineral.—In British bottoms alone there were exported, in 1831, above a million and a half

of lbs.; but it is probable the junks carry away to the various settlements connected with the empire a larger quantity. Tutenague or zinc, obtained from the mines of Yun-nan, used to be largely exported, until German spelter, a less pure but much cheaper article, was introduced about the year 1822, and has nearly superseded it.—The paper of China, supposed to be manufactured from bamboo-cane, is brittle, from the too copious use of alum, and is greatly inferior to the European fabric; but being much cheaper than this last, it is used even in our Indian settlements for all ordinary purposes. The Chinese porcelain, which was so largely exported before the western nations borrowed the art, is still an important article of commerce. It furnishes, indeed, all the inhabitants of the Eastern Islands, from Sumatra to the Phillippines, and the tribes from the western border of China to the eastern frontier of the Burman country, with the principal portion of their culinary vessels; even the Persians and Arabians make use of it, receiving their supplies by Bombay. The quantity annually bought by the British does not exceed in value eight or nine thousand pounds; but the Americans purchase to a much larger amount. It may be mentioned, that the total value of manufactured articles exported by the English and Americans in 1834, excluding from this computation raw silk, refined sugar, and silver bullion, exceeded two millions of Spanish dollars.—[Edinburgh Cabinet Library, Historical and Descriptive Account of China, Vol. 3.

The Chinese Duck.—On the lakes and rivers there are of course many kinds of wild ducks and other waterfowl, in their natural and unreclaimed conditions; and the manner in which these are often captured is ingenious, though well known. The sportsmen incase their heads in large gourds or calabashes, with holes for sight and respiration: they then walk or swim deeply in the water, so that nothing but the fruit is seen above the surface; and the unconscious ducks, accustomed to floating and innocuous calabashes, approach them without fear, and are respectively pulled under water, for the purpose of having their necks wrung, and being fastened to a poulterer's gridle. On the banks of the Yang-tse-kiang, and along the shores of the Po-yang-hou, during the progres of Lord Amherst's embassy, wild ducks and geese occurred in large flocks on both the lake and river, and were so tame that they might be approached within a few yards. It is known that prodigious numbers of tame ducks are kept in the various provinces. The peasants hatch the eggs in ovens or in dung, and putting the young ones into boats carry them down to the sea shore at low water; and as these boats keep company, there are consequently several flocks of ducks, not only near each other, but frequently intermingled, while searching for shell fish or other marine productions. Yet no sooner does the guardian strike upon a basin, than each flock flaps away to its own boat. Indeed, among the more singular sights to be seen in the neighborhood of Canton, particularly about Whampoa, are the duck boats, which not only contain the aquatic bibeds, but are used as the dwelling of their owners. The ducks inhabit the hold, while the keepers are accommodated in the upper portion of the vessel. These boats are very abundant about the rice fields near the river, just after the harvest has been gathered in, the birds at that period being able to glen a plentiful supply of food. Each owner moves about from place to place according to the favourable opportunities that may offer for the feeding of his broad-billed flock. "On the arrival of the boat," says Mr. Bennet, "at the appointed spot, or one considered proper for feeding the quacking tribe, a signal of a whistle causes the whole to woddle in regular order from their domicile across the board placed for their accommodation, and then rambling about undergo the process of feeding. When it is considered by their keeper that they have gorged sufficiently, another signal is made for the return of the birds; immediately they congregate and re-enter the boat. The first duck is rewarded with some paddy, the last is whipped for being dilatory; so that it is ludicrous to see the last birds (knowing by sad experience the fate that awaits them) making efforts *en masse* to fly over the backs of the others, to escape the chastisement inflicted upon the ultimate duck."—[Edinburgh Cabinet Library, Historical and Descriptive account of China, Vol. 3.]

Chinese Art of Computation.—The Chinese, in their arithmetic, employ the decimal notation and they perform its operation by means of an instrument called *Swan-pen*. It consists of a frame, divided into two compartments by a bar in the direction of its length. It is next crossed by ten wires or slender rods, which pass through the middle bar, and terminate in its longitudinal opposite sides. Each corss-rod has on it seven moveable beads, which admit of sliding backwards and forwards; five of these are on the part of the rod between the sides of the wider compartment,

and two on the part which crosses the narrower. Beginning from one extremity of the frame, each of the five beads on the longest part of the first rod represents a unit, and each of the two on the shorter stands for five. In like manner, each bead on the longest part of the next rod, towards the left hand, stands for ten, and each on the shorter part for five tens or fifty, and so on. It is easy to understand, that by detaching a proper number of beads, which represents units, and tens, and hundreds, &c., by sliding them from the position in which they are represented in the figure, towards the bar which crosses the rods, any number whatever may be indicated; a single bar on the shorter part of the rod answering to all the five on the longer. In this way the Chinese perform their arithmetical operations, just as men reckoned by counters in this country in the manner explained by the old writers on arithmetic, particularly by Robert Recorde, who lived about the time of Queen Elizabeth. The *swan-pen* seems the more convenient mode of the two; and by its assistance the traders in Canton transacts their business with a dexterity and expedition quite remarkable. It must, however, be admitted, that although this machine be well adapted for explaining the principles of arithmetic, it would be a very inadequate subtitute for our Arabic numerals, more especially in those laborious calculations which the progress of European science has rendered indispensable.—[Edinburgh Cabinet Library, Historical and Descriptive Account of China, Vol. 3.]

China Deficient in Timber.—China, like every other country which is densely inhabited, is deficient in the supply of timber and dyewood. The neighboring countries, therefore, which are in a rude state, furnish it, in the same manner that America and the north of Europe supply England, France, and Holland; and if capital were abuudant, and freights low, they would export a much larger amount. The supply of wood and other rude produce from the surrounding countries, is a branch of trade into which we think it not improbable that the British merchant will sooner or later enter. The timber furnished at present consists chiefly of fancy-woods; as sandal-wood, from Malabar, the Sandwich and Feejee Islands; that of the first is nearly three times as valuable as those of the two last, being of greater size, and containing more essential oil. The English and Americans, in 1834, imported of this commodity about 300 tons, worth 50,000 Spanish dollars. Rosewood comes from Siam, and ebony from several of the Malayan Islands, but the best as well as the largest quantity of late years has been sent from the Mauritius, while the inferior kind is brought from Ceylon. The woods or barks for dyeing, consists chiefly of sapan-wood from Siam, and the barks of several species of *Rhizophora*, or mangrove, from the Malayan Islands. Under this head may be mentioned rattans and canes, of which the importations, both by native and European vessels, chiefly from Borneo, Sumatra, and the Malayan Peninsula, are very large for such a commodity. We perceive tha, of the former, the weights imported by British ships, in 1830, was equal to 35,000 cwt., valued at about £18,000.—[Edinburgh Cabinet Library, Historical and Descriptive Account of China, Vol. 3.]

Patent rotary printing-apparatus.—A patent has recently been taken out by Mr. Rowland Hill for a rotary printing-machine. The types are imposed* upon cylinders, to which they are firmly attached, and of which, except the marginal spaces, they occupy the whole surface. The pressure is given by blanket-covered cylinders of the ordinary constr ction.

The most important advantages of this arrangement are stated to be, first, That as the revolving type cylinder is constantly receiving its ink in one part of its revolution, and constantly impressing the paper in another part, the action of the machine is unceasing; whereby a saving of time of about three parts out of four is obtained in comparison with the ordinary printing machines, when moving at the same velocity; because in those machines the backward motion of the form,* and the laying on of the ink, suspend for the time the process of printing. Further, as the motion of the type in this machine is continuous instead of reciprocating, the speed has been increased without difficulty or danger; and by this additional velocity, combined with the saving of time just described, the rate of printing is brought to about ten times that of the ordinary perfecting machines, i. e. those which print the sheet on both sides before it leaves the machine. Secondly, the reciprocating motion of the heavy form, inking table, and inking rollers of the ordinary machiue entails such a loss of power and time, in comparison of the rotatory motion which is here substituted for it, that it is believed, from careful observation, that, notwithstanding the great increase in speed, any given quantity of

*These words are used techincally.

work will be executed at the expense of about one-eighth of the power required in the ordinary machine.

The facilities provided for fixing the type, detaching parts for correction, applying the ink and regulating its supply, are said to be fully equal, if not superior, to those of other machines.

Compared with the rapid machines used for printing the daily newspapers, the rotatory machine will print two sheets on *both* sides with accurate register, while they print *one* sheet on one side with defective register.

SHORT AND LONG SCREW-DRIVERS.—Electric or minor elementary matter lessens pressure on a body, owing to the momentum of its atoms being as their size; to which may be added, the farther from the source of power, the more reduced is the effect, which is exemplified in any system of machinery depending on a single motive power, and turning an extended spindle, the motion of which keeps remote mechanism in motion. The more simple exemplification is that of that of a turn-screw and the hand. The carpenter imagines, that with equal force of hand a long turn-screw is more powerful than a shorter, because the longer turns a rusty screw, which by a shorter cannot be moved. The fact is, power is lost by the long one: resistance it is which is reduced. The longer is the lesser power. In screwing, the force is in the direction of the required effect forward; in unscrewing, it is the same to produce the contrary effect. A screw of difficult removal is much pressed in a direction the contrary of what is wanted; to make it ascend is the object—pressing it into the wood, the act. In unscrewing, the hand uses its force in two directions—forward, to keep the tool in the slit of the screw; rotary to produce the turning, and consequent ascent of the screw. Lessening the forward force on a screw is the object gained by the longer instrument; the whole of which forward force is got rid of, when the screw has a head which admits of a winch. The tool may be uselessly long; the forward force by the hand being as before, it may be insufficient to command the position of the tool in the slit, and too weak to produce any turning effect; or should the slit be deep enough, the greatest effect will be on some part of the blade of the tool in a twisting direction. The carpenter little thinks that his exertion is employed oppositely to his intention or against himself, the turning effort by one hand having to overcome the forward effort by the other.—[Pasley's Natural Philosophy.]

ORNAMENTAL SLATE MANUFACTURE.—Slate of late years has become extensively useful, and its application to new purposes is of every-day occurrence. A Mr. Stirling has for some time been laboring to bring it into use as a material for the manufacture of various articles of furniture, and, from the specimens which we have seen, we think it likely that he will meet with complete success. Tables of all kinds, side boards, wash-hand stands, and other articles of a similar nature, and which do not require to be often moved (as slate is, of course, heavy), may be made of it decorated in the most elaborate style. The natural texture of the slate, it has been found, is peculiarly applicable as a ground for the reception of colors; and Mr. Stirling has some specimens of tables with a wreath of flowers round the edge, and a group in the centre, most beautifully executed—the neutral tint of the slate forming an appropriate back-ground. A very beautiful and appropriate application of the article has been made in the formation of door-panels. The General Steam Navigation Company has, we understand, given orders for the fitting up of the saloon of one of its new steam-vessels with these panels, painted with groups of fruit, flowers, and designs of a like nature. Amongst the numerous other articles of slate manufactured by Mr. Stirling, we shall merely particularise his door finger-plates and ink-stands, which are extremely beautiful.—[London Mechanic's Magazine.]

BUSTS.—A new instrument has been invented in Paris called the physionotype, for the moulding of busts, on a principle which renders the likeness to the original a mechanical certainty. Busts in plaster are thus produced for five francs each. Another machine, entitled the portrait mirror, has also been constructed, by which a portrait may be taken in twenty minutes from the reflection of the face of the original in a looking-glass.—[Athenæum.]

From the Journal of the Am. Institute, for August.

REPORT FROM THE HON. HENRY L. ELLSWORTH TO THE SECRETARY OF STATE, AND TRANSMITTED TO THE SELECT COMMITTEE ON THE PATENT LAWS.

PATENT OFFICE, 1836.

SIR: I have the honor to acknowledge the receipt of the inquiries made by the honorable chairman of the committee on the patent office, in the house of representatives, and referred by the honorable Secretary of State to this office for my report in part. As the answer must in some measure depend upon the organization of the office, I will respectfully reply, first, to the following inquiry, viz: "what alteration or improvement of the law, relating to the granting of patents, has experience shown to be requisite to effect all the objects which it is desirable to obtain in this department?" A brief reference to the history of the patent law, and the practice under it, will be necessary to learn the "mischief," and provide the "remedy."

It is nearly half a century since the present patent law was enacted. Previously to 1793, all petititions for patents were presented to the Secretary of State, Secretary of War, and Attorney General, who examined them, and granted or refused a patent at their discretion. This duty having been found an arduous one, and also a great interruption to other business, the law of 1790 was repealed, and the present act passed, which is more in conformity with the practice in Great Britain.—Few alterations have been made in the existing law since 1793, if we except the extension of a privilege to a certain class of foreigners. While a laudable spirit prompted our legislators to encourage the arts, the poverty and distresses of the country forbade the passage of any law for the protection of inventors which might increase the burdens of the community. Such a tariff of fees was accordingly established as to defray, as far as possible, the expenses incurred by government in giving patents. Hence it is not strange, that glaring imperfections now appear in the law. It has been a matter of astonishment that so important a branch of domestic polity should have been so long neglected. The time has now arrived when the amount of revenue derived from this source, the magnitude of the claims dependant upon the patent law, the great delay and embarrassment experienced by patentees at the office, all conspire to demand a thorough survey of its present organization. To insure attention to this subject, it need only be mentioned that the number of patents issued annually, for a long time, did not exceed one hundred, whereas, at present, the number is about eight hundred, and will soon increase to one thousand. Such is the desire to secure patents, that individuals have taken out more than fifty patents. The amount of fees for patents annually ($30 being the fee) is about $25,000. The present year it may exceed $30,000. To this amount fees for copies and recording are to be added, making the sum larger still; and notwithstanding the rapid increase in the business of the office within a few years, very little additional force has been allowed for its accomplishment. Patentees complain of delay, and very justly, but this delay must soon be greater than at present, without the interference of congress. It may be asked if such are the profits, why not apply the funds received to the discharge of accruing business?—The answer is readily given. All the money received is, by law, paid over into the treasury, and although to be credited to "the account of clerk hire," cannot be appropriated to this use without a special act of congress. The superintendent has requested additional assistance, but the honorable Secretary, although anxious to afford every facility, has not felt authorised to increase the expenditures on his own responsibility. Patentees and suitors in courts have suffered much during the last year from delays in the office; cases are sometimes continued for the want of copies, which would readily be furnished at one half the lawful fees now charged if the superintendent was permitted to get the work done. A few facts need only be added, to show the propriety and importance of a revision of the patent law. The whole expenses of the patent office do not exceed one-fourth of its income. The number of applications for patents since the 10th of July (at which time my superintendency commenced) has been upwards of six hundred. The correspondence has trebled within a few years. No less than two thousand letters have been written by the superintendent since July last. More than

one hundred suits are now pending in the United States courts touching rights of patentees. These suits will increase until some check is put to the fraud now openly practised, but irremediable without the aid of congress.

Questions are frequently asked at the patent office, which require several days search to answer. Each patentee (if he is honest) wishes to know whether his patent will infringe upon others. This is apparently a simple inquiry, but only a reference to seven thousand patents can settle the question. And here, what an embarrassment must arise from the want of systematic arrangement of the papers. Previous to July last, not a single letter received was filed, and even now none are indexed. Many volumes of records are also wholly unindexed, and must remain so until more help is provided. And was not an hourly reference to these volumes and correspondence necessary, the unsystematic arrangement of papers would be less tedious and perplexing.

The injustice and inexpediency of the present law, will appear in reference for the charges made for services performed at the office, besides the fee of thirty dollars. By the law of 1793, each copy of one hundred words is charged at twenty cents, certainly twice as much as it costs to make the copy, if labor is computed at one thousand dollars or twelve hundred dollars per year for a clerk. It may be mentioned, as a singular fact, that copies of the papers in the State department, are charged only ten cents per one hundred words. Each drawing, whatever its size or complexity, is charged at two dollars. A few drawings are worth less than this sum, but most of them twice as much, and some are worth forty or fifty dollars. A fair remuneration ought to be charged to each applicant.—There are now applications pending for drawings, where the draughtsmen will be compelled to labor several days, at a salary of three dollars and thirty-three cents per day, and earn for the government but two dollars for the whole time.

So sensible are the patentees that the price is much less than the usual charge for the same thing out of the office, that they frequently apply to the superintendent to get the original drawings executed in the office at two dollars. This request is always refused, for patentees are bound to furnish original drawings, and the patent office is only required to give copies of drawings of patents granted.

The delay of patents has been alluded to. This is one of the greatest evils. Applicants are always impatient ; some travel to this place from a long distance, and are anxious to carry their patents home with them ; other patentees are urgent for papers to be used in courts ; especially where old patents are adjudged invalid, and the right of action is suspended until a new patent is obtained ; nor will an additional number of Clerks produce the desired relief, without some alteration of the present requisites. According to the existing law, the patent must be signed by the *President*, the *Secretary of State*, and the *Attorney General*.

The Attorney General has the right to retain the patent fifteen days for examination. It must be apparent to all conversant with public business, that there will be delay in the signatures of such high functionaries, since their time is demanded for more imperious duties. How much greater must this delay be, when the person whose signature is wanted, is absent from the seat of government ; nearly one half of the patents issued since July have been transmitted more than two hundred miles for single signatures. It may be asked, how is this difficulty to be remedied ? it is believed that two of the three signatures can be dispensed with ; can it be necessary or useful to have the whole number ?

The rights of the patentee are the same with the signature of the Secretary of State, as with the addition of the President and Gttorney General. The great seal can accompany the Secretary's signature, and the patent be issued in the name of the United States. It is true the Attorney General is bound to examine the patent ; but is this necessary ? Among all the patents transmitted since July, only one has been returned as imperfect, and in this case the defect was not fatal to the validity of the patent. The best examination can certainly be made at the patent office, where the drawings and models are deposited. If the signature of the president and Attorney General could be dispensed with, considerable labor and much interruption would be avoided. If additional help was

given to examine the patent and the signatures of the Secretary of State, and the head of the bureau, only required, it is believed that a patent might be issued in a few days, whereas now the average time is two or three months.

The present arrangements are not economical. Congress appropriated, a few years since, $14,000 to bring up the records of the office by employing clerks at a compensation not exceeding twelve and a half cents for every hundred words. A small part of this appropriation remains unexpended, and a temporary clerk is employed under the act. The employment of temporary clerks is objectionable: unskilled, they are liable to commit errors; besides, the compensation of twelve and a half cents per hundred words is much higher than the salary of a clerk at $1,000 or $1,200. It is due to those who labor in the patent office to state, that services required and performed there are not exceeded in any of the bureaux of government. Great caution, much skill, and some legal science, are requisite in issuing every patent.

Notwithstanding the superintendency is in form a separate bureau, (yet in law a clerkship,) and the superintendent charged with the whole responsibility of issuing the patents, disbursing the special appropriation of $14,000, and the contingent fund of $2,000, accountable for all the fees received in the office, and personally required to conduct the correspondence, still his compensation is lower than that of chief clerk in either bureaux of auditor or commissioner. If the patent office was placed upon the same footing with the land office or Indian bureau, the compensation allowed would secure competent assistance. And it is desirable that those who are in the office should receive a fair remuanration as an inducement to remain after they have become acquainted with its minute details. The salaries in the patent office, as compared with those of the land office, Indian bureau, or either auditor's office, will be found from thirty-three to fifty per cent. less. Hence there is in the patent office a constant desire to change situations, and this comparatively low compensation will prevent able and permanent assistance.—Will a clerk remain satisfied to labor for $1,000 in the patent office, when the same clerical services in adjoining offices bring $1,250 to $1,500. The aggregate pay of superintendent, three clerks, machinist, and messenger, in the patent office, amounts to $5,400, whereas the pay of the commissioner of Indian affairs, four clerks, and a messenger, is $8,700. One third of the revenue received from patents would defray all the disbursements for salaries, and leave two thirds to be appropriated as congress might direct.

I have alluded to frauds under the patent law. These frauds are daily practised by persons who take out patents without making any new discovery or improvement.—The law gives neither the superintendent nor others any judicial powers. Every applicant has a right to demand a patent if his papers are in order; and several patents are often issued for the same thing. Congress seemed to have noticed the impropriety of granting two patents for the same thing by giving the Secretary power, in case of two pending interfering applications, to order them both to arbitration to decide upon the right of patent, but under the rules established to direct the office no applications are deemed interfering unless the papers of both are complete in all respects.—Should two applications be precisely alike, and one of them need only a trifling requisite, such as an additional witness, it then would be no interference; and as there is seldom a case when the papers of both are in the same state of forwardness, an arbitration under the law is a rare occurrence.

The oath of inventors has been too often justly compared to the "custom-house oaths." There are, however, inventions made by persons living in different parts of our country, when both can claim originality; for no sooner are the wants of the public known than men of ingenuity attempt to supply them. The late burning of baggage on railroad cars produced immediately many inventions to remedy the evil, and several interfering applications were made. The issuing of patents to those who have no claim to originality is truly a great evil. Every facility is now extended to pirates. Even copies of models are taken by visiters at the model rooms, and patents demanded of a similar kind. During the last week a patentee was explicitly told that his patent,

if granted, would be a direct infringement upon previous patents: "but a patent must be had;" it was demanded, and accordingly ordered to issue. It is believed that several hundred thousand dollars are paid annually in the United States for patents improperly obtained.

The success of past villany has emboldened many to continue their deception upon the credulous. The public attach high reverence to the great seal which the patentee is careful to exhibit. Fraudulent patentees are shielded in some measure by the expense of litigation, and many, very many, pay commutation, and submit to imposition, rather than be dragged into courts of justice. How easily, for instance, can an individual take out a patent resembling one granted to a citizen of Maine, and sell the same in the south-west part of the republic! An arrest of the infringer might be uncertain, and indemnification still more doubtful. The pirate, after selling out his rights to States, counties and towns, might easily pass over the borders of our territories and be safe. There are a great number of cases arising out of the patent law before the United States courts. How much will the number be increased when the eight hundred patents granted this year shall appear with their many interfering specifications? There will be a rich harvest for the lawyers; but how many honest mechanics and inventors will be ruined by the expense of litigation. Is there no remedy?

The remark of Mr. Jefferson, who, while Secretary of State, was one of the board of examiners of patents, is worthy of observation. In his letter to Mr. Cooper, on this subject, he writes, "instead of refusing a patent in the first instance, as the board was authorised to do, the patent now issues, of course, subject to be declared void on such principles as should be established by courts of law. The business, however, is but little analogous to their course of reading, since we might in vain turn over all the lubberly volumes of the law, to find a single ray which would light the path of the mechanic, or mathematician. It is more within the information of a board of academical professors, and a previous refusal of a patent would better guard our citizens against harassments by lawsuits. But England had given it to her judges, and the usual predominancy of her examples carried it to ours." I would respectfully suggest the following remedy: To vest in the head of the patent bureau, or some other tribunal, a discretion to arrest a pending application for a patent, if it interferes with any prior patent, or caveat on file, and also if the application is destitute of novelty.

If scientific men could be induced to take an office in the patent bureau, as examiners of patents, their examinations, aided by a suitable library, would detect almost every interference or want of novelty. Nor is it to be believed there will be any objection to appropriate the sum necessary to obtain a good library.

To show the importance of possessing the foreign works of art, on the subject of patents, I would remark, that in looking accidentally at a German work, a discovery was there found, delineated in a drawing, which has been patented in this country, and which is now selling as a new invention. A complete collection of prints and books, in reference to the patent law, would be highly useful to patentees, and citizens in general, as well as the courts of justice. Caveats in the United States, though frequently entered, give no protection to the inventor. The existence of the caveat can be attested as evidence of certain knowledge at the date of the same, but proof furnished from the patent office gives no additional weight to the testimony. In England a caveat protects the inventor from interference for a certain period, during which time, if any interfering application is made, the person who entered the caveat is notified. An exparte hearing is had before the Attorney or Solicitor General, who decides upon the case; if there is an interference, one of the applications is rejected.

I ought, however, to remark, that such in England is the danger of giving publicity to inventiona before signing the patent, that caveats are kept secret. Indeed, so great is the anxiety to conceal from the public the discovery, that the letter of the invention is sometimes only lodged for a caveat, as for instance: "New improvements on steam engines," "spinning cotton," "navigating vessels," &c. Great importance is attached to the novelty of the invention; hence, when artists in the employment of an inventor have mentioned to a stranger

the discovery, and that stranger has by dexterity set up a model of the same, even after application for a patent, and before signing it, the patent has been lost for want of novelty. Our courts have adopted a more liberal policy, and very justly decided that public experiments to test the value of the invention, do not destroy the right on the ground of publicity.

In conformity with the established decisions of this country, a caveat, if recognised by law, could be safely lodged on file, describing (as fully as possible) the whole invention, to protect the inventor against interfering applications. Our law also makes novelty a requisite for a good patent. Many have supposed the example of England and other foreign governments worthy of imitation by us. Patents in England are not confined to new discoveries there, but granted upon importation, or introduction of discoveries from abroad, and this is done upon the principle, that the arts will be benefitted by the encouragement afforded. On this point much might be said. When this system was adopted in England, communication with other countries was comparatively limited, and the improvements in the arts correspondingly low. But at the present time, such are the facilities of intercouse, and such the reading spirit of the people of the United States, that it is evidently better to confine patents here to new discoveries.

Scientific journals bring speedily to our shores every invention from abroad, and these inventions are introduced into immediate use, with barely the cost of manufacture. Who except the patentee would be benefitted by the issue of a patent for a foreign invention? thereby increasing the price at least thirty-three or fifty per cent. There would seem no occasion for offering further bounty to patentees. During the last sixty days, more than two hundred applications have been made for patents, a number greater than the average number issued annually in England for the last ten years.

I cannot omit noticing one thing more, viz: in the failure of the patentee to sustain his patent, if he claims more than is original, or presents a defective description. The description of the whole object, however limited the improvement, is a common error. The patentee knowing fully the extent of his own discovery, or improvement, ought certainly to specify the same with perspicuity. Cases will arise, however, where (in a large machine for instance) some small part described might not be new. Here a trifling error destroys the patent. While there is no sympathy for fraudulent patentees, who attempt to deceive the public by patented discoveries, there is some feeling for an honest mechanic, who, having published his patent, and believing it to be correct, is not only deprived of recovering any damages of the infringer, but obliged to pay cost to a defendant, who has enriched himself by the discovery of the plaintiff. In England an effort is making to prevent a total failure of action for partial defects, by authorising certain disclaimers to be put in a subsequent procedure to judgment. The principle upon which surrendry of invalid patents is permitted in this country, is an expeditious mode of correcting errors arising from "mistake," or "inadvertence." And if a discretion was allowed to the court, to tax or withhold costs in favor of the defendant, our practice would be more simple than the complex pleading which disclaimers must introduce. Such is the temptation to patent in this country, that it might be well to compel each patentee to publish his specification, or at least his specific claim.

We can scarcely eat, drink, sleep or work, without using some patent. Take for instance the farmer; he dares not use a plough without paying for the patent right, when, perhaps, the only new thing claimed in the specification of the patentee who offers this fine plough, is a simple *bolt*.—While cupidity induces patentees to connect their improvements with inventions of others, ostensibly claiming all as their own, it is certainly proper that the government should annex some penalty to such imposition. A judgment against the validity of the patent, is a suitable penalty. Should it appear objectionable to confer the power of arresting interfering applications on the head of the patent bureau,&c.,the objection may perhaps be lessened, by referring the interference to three indifferent arbitrators, skilled in the art in question, and as the arbitrators might make an improper award, an appeal could be allowed to the Secre-

tary of State, or other tribunal. The present mode of appointing arbitrators in interfering applications, is to allow each party to choose one, and the Secretary of State the third. This makes a court of strong bias, as each applicant generally selects a particular friend. I ought to add that, at present, there is no compensation allowed or paid to arbitrators. Each appelant might be required to pay a reasonable fee, to be fixed by law. Interferences will generally be found to arise from ignorance or fraudulent intent. Information will correct the former, while a rigid scrutiny will induce impostors to withdraw their pretensions. It should be recollected that the first applicant is not always the original inventor; those who pirate upon inventions are generally dexterous in securing their patents as soon as possible. In such case, where the honest inventor has not been guilty of gross neglect, equivalent to a legal abandonment of his right, the superintendent might allow the patent to issue, and the rights of parties would be settled in a court of justice; these cases will, however, be of rare occurrence. Should the above remedy not be thought expedient, an entry on the patent issued that it was deemed an infringement, or was destitute of novelty, would, it is believed, go far to check improper issues, and caution the public against imposition. It has been supposed if a small part of the money received from patents was appropriated for the publication of all specifications of patents, or at least the claims under the specification, and the distribution of the same in different States, the money would be well spent. The public would then know what patents were issued, and be able to guard against spurious ones. Copies could also be easily procured without sending to the patent office, and the publication might be made with so much care as to justify the introduction of the published copies as prima facia evidence in courts of justice.

There is a common error in the assignment of patents; partial assignments for States, counties or towns, are not recognised by law; and still such a large amount of property is now held, in this manner, that it deserves consideration whether some provision should not be introduced to remedy the evil in future, and to protect past assignments. Few patentees seem to understand the law of assignment; the present law authorizes an assignment of the whole patent, or any individual part of the same, as one-half, one-third, one-fourth, &c. But the assignee must stand in the place of the original inventor, both as to right and responsibility. In the United States courts, where a plaintiff averred himself the assignee of the original inventor. with the exception of three counties in one State, a non-suit was ordered, because the plaintiff, by his own shewing, proved himself not to hold any legal right under the assignment. It is respectfully suggested, whether the time allowed for recording patants should not be limited. The same reasons for a limitation applies to transfers of patents as to transfers of real estate. It has been before remarked that the fee of thirty dollars is paid into the treasury. It often happens that this is the first step taken by the patentees. A farther examination satisfies the applicant that his patent could not be sustained, and he, of course, seeks to recover his money.—This, however, having passed into the treasury, cannot be paid without an application to congress; the sum is a small one; too much to lose, and yet hardly worth the trouble and expense of recovery.

Applicants often forward the thirty dollars directly to the superintendent, supposing that he is authorized to receive the money. As he is not permitted to do this, it becomes necessary for him to return the money, however distant, for the applicant himself to pay into the treasury. It is suggested whether the head of the patent bureau could not, (by giving bonds, if required,) receive and pay over this money directly into the treasury, and save the hazard and delay of remitting it to the patentee; and it is also suggested, whether there would be any danger in authorizing the treasury to repay such patent fees as should have been received into the treasury through mistake or ignorance, upon a petition approved by the superintendent of the patent office. In answer to the inquiry, what additional room is needed for the patent office, I would observe, that the building in which the patent office is now kept, was finished for the joint use of the post office and patent office. It is evidently too small

for both. The post office department needs the whole building, while the rooms allowed to the patent office are entirely too small; the model rooms are full; several hundred models are stored away in the garret.—Those now received are piled up, waiting for better accommodations, and what shall be done with the thousand models to be received annually? While it becomes necessary to procure more room for the patent office, it is desirable that some should be rendered as secure as possible from fire. The destruction of the present models and records would produce very great embarrassment, especially as so many original patents and assignments are lost. It is a satisfaction to state that the patent office has not been, and need not be, onerous to the government. There now remains in the treasury about $150,000 to the credit of the patent office, after paying all expenses since its first organization. A part of this sum would furnish a commodious and permanent building: and should all the patents be so arranged, in systematic order, to show the progress of the arts in the country, it would be an exhibition highly gratifying, as well as instructive. The present limited room prevents such an arrangement. In answer to inquiry, what additional expense would be incurred by an exhibition of the models of machinery, and specimens of fabrics and other manufactures and works of art not patented? I reply, that the keeper of the models in the patent office could superintend this exhibition without any extra charge, and when rooms were constructing for patented models, additional rooms could be made for the reception of fabrics and models unpatented, with little expense.

It is believed that there are many inventors who would delight to exhibit their improvements in machinery and manufactures, if room was allowed them, while they do not desire to take out a patent; such a collection and exhibition would be a repository of national ingenuity, and might be made highly honorable to the country. Who could fail to be instructed by such an exhibition? And who that was about to invest in machinery, would not be amply compensated by visiting the patent office. The exclusion of foreigners from the benefits of the patent law cannot fail to be noticed as an exception to that reciprocity which this government has ever cherished. Citizens of the United States are daily taking out patents in France and England, and the subjects of those countries are greatly disappointed in being refused a similar privilege here. Congress has sanctioned the principle of granting patents to foreigners who apply to that body. Should foreigners be permitted to take out patents, and pay fees corresponding to those demanded of our citizens in their countries, it would not be inequitable. The following table will show the comparative charges in several countries for patents:

In Great Britain, or England, and colonies	122£		$542 21
Scotland	19		84 16
Spain	60	16*s.*	299 97
Ireland	137		607 77
France	46	10	206 66
Austria	43	06	196 68
United States of America	6	10	30 00

It would be desirable that all foreigners should be allowed to take out patents for a fixed sum, (perhaps one hundred dollars,) since it would be difficult in some cases to ascertain what the particnlar country to which the patentee might belong charged for the same. By the present law, foreigners residing here two years are allowed to take out patents on the same terms as citizens. There is an evident propriety in granting patents to those who declare their intention of becoming citizens. Why visiters for two years should enjoy any privileges over other foreigners does not readily appear. I now proceed to answer more definitely the remaining inquiry. How many persons are necessary for the prompt and efficient performance of all the duties connected with the office, and what should be the respective and particular duties.—Under the present organization two additional clerks are absolutely necessary.—This would give the following force: one superintendent, three clerks, one examiner, one draughtsman, one machinist, one messenger.

The duties might be distributed as follows:

The superintendent to conduct the correspondence; issue the papers for patents; and exercise a general supervision. Chief

clerk to keep the accounts; compare records and transfers; index caveats; file the applications for patents, and transmit the same; and aid, if required, in the correspondence. Second clerk to transcribe on parchment the specifications. Third clerk to aid in transcribing specifications; and filling up patents, and recording the same; and recording letters. An examiner, who should compare, critically, every specification, drawing and model; ascertain its interference with pending applications. The duty will be very arduous, some specifications containing ten or twelve pages of closely written matter, with many references to drawings. In this duty the examiner might be assisted by a scientific draughtsman, whose labor in drawing could only occupy part of his time. A machinist is necessary to repair the models and keep them in order; to classify and arrange them; to exhibit them to strangers; and to answer the many inquiries made respecting them by patentees and visiters.—The models are of much value, and the large rooms should have at least one person in attendance to protect the property. A few models have already been injured by visiters. What effect the new organization might have in reducing the number of patents cannot be determined. Some present duties would doubtless be lessened by the proposed alterations; others would arise; applications would require a very strict scrutiny to detect interferences with prior patents, or a want of novelty. To avoid the embarrassment from the delay in furnishing copies where the pay is specific, it is most respectfully submitted, whether it would not be advisable to authorize the head of the patent bureau to emply (if necessary) occasional assistance in transcribing said copies, reimbursing the whole expense from the fees received. This discretionary power would dispense with the appointment of another permanent clerk, and meet the sudden exigencies as they arise, without suspending the ordinary business of the office. I have omitted to mention that a few hundred dollars will be required to procure suitable tools for the machinist to repair the models.

I am, most respectfully, yours,

HENRY L. ELLSWORTH.

Hon. SECRETARY OF STATE.

From the Journal of the Franklin Institute

EXPERIMENTS ON THE RESISTANCE OF SAND TO MOTION THROUGH TUBES, WITH ESPECIAL REFRENCE TO ITS USE IN THE BLASTING OF ROCKS, MADE AT FORT ADAMS, NEWPORT HARBOR, UNDER THE DIRECTION OF COL. TOTTEN.—BY LIEUT. T. S. BROWN, OF THE CORPS OF ENGINEERS.

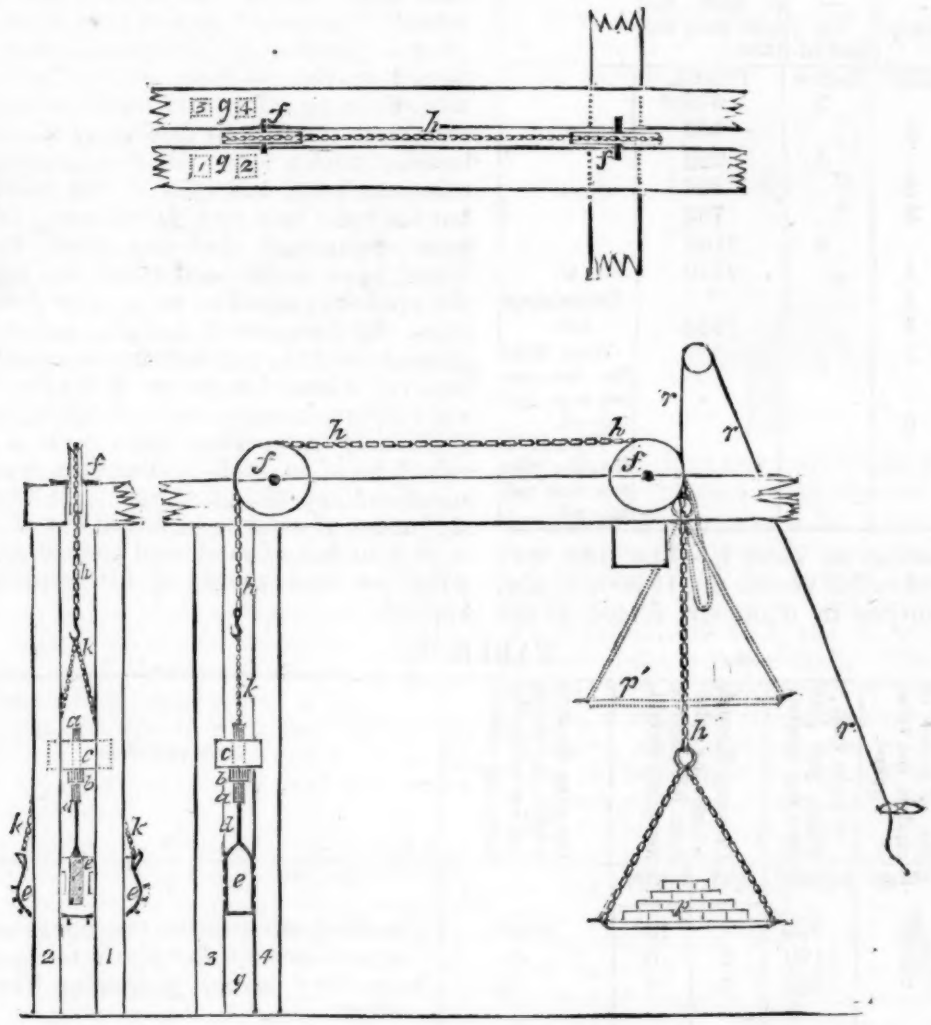
Coutinued from page 118.

For the purpose of examining further the degree and nature of the resistance offered by sand when it is attempted to force it through a tube by direct pressure, the following apparatus was arranged, after a a few preliminary trials, which had given some idea of the power it would be necessary to apply. A side and end view, and a plan of the apparatus are given in the cut on the next page.

The strong cast composition tube, *a*, about fifteen inches in length, which contained the sand, was held in a vertical position by being passed through the block, *c*.—The pressure was always applied to the bottom, and the collar, *b*, cast upon the tube, prevented its being forced upwards. The block *c*, was secured in its place by being let into the four posts, 1, 2, 3, 4, passing from the floor to the ceiling. These four posts formed a very stable frame work, and between each pair, the space, *g*, permitted the sliding board, *e*, to move freely up and down, and secured the proper direction to the pressing force. For the sake of distinctness this space, *g*, has been represented wider on the sketch, and the sliding board, *e*, thicker, than they actually were. The pressure was applied by means of a moveable piston within the tube, connected by means of the iron rod, *d*, with the sliding board, *e*. This sliding board was attached, by means of the chains, *k*, *k*, *h*, *h*, *h*, passing over the cast iron pullies, *f*, *f*, to the platform, *p*. Of course any weight placed on this platform communicated a corresponding pressure upwards to the piston within the tube. The chain *h*, *h*, was of the best Peru iron;* the wire was about ½ an inch in diameter, and the chain had been proved with 9 tons dead weight. The pulleys, *f*, *f*, were about a foot in diameter; and their axles were of wrought iron an inch and a half in diameter. When a dead weight was to be applied, the platform was loaded in the position, *p*, but if a violent shock was to be produced, the platform was held in the position, *p'*, by means of the cord, *r*, *r*, *r*, until it had received the proposed load; the

* Peru, Clinton county, New-York. The iron from this locality possesses a remarkable degree of tenacity.

cord, *r*, *r*, *r*, being then suddenly cast loose, permitted the loaded platform to fall freely by its gravity, until it had straightened the chain, when it was either entirely arrested by the resistance of the sand in the tube, or it forced its way to the floor in consequence of the yielding of the sand, or of the fracture of some part of the apparatus.



There were other minor details which it is not necessary to particularize. The fixtures were not brought to the degree of strength just stated until after many trials, and the repeated failure of nearly every part of the apparatus; and, as will be seen, a limit was soon attained, beyond which the experiments, even with this degree of strength, could not be carried. The weights used were bricks. The piston was so arranged as to move without friction when the tube was empty, and at the same time to prevent the escape of the sand when the tube was charged. Trials were made with sand poured loosely into the tube, and with sand carefully packed. The packing was performed by means of a sharp stick which was worked up and down in the sand as it was slowly poured in. This method was found to be the best, and is the one always used at Fort Adams, in charging drill holes for sand blasting. The sand used was dry and free from dust, and from all particles which would not pass through a hole $\frac{1}{14}$th of an inch in diameter.

A preliminary series of experiments was tried, the results of which will not be given, as they were all subsequently repeated in a more careful and accurate manner.

In the second series, a tube of tin, fifteen inches long, having an interior diameter of $1\frac{1}{4}$ inches was used instead of the cast composition tube, *a*, above described, and a $3\frac{1}{2}$ inch bolt-rope instead of the chain, *h*, *h*, *h*. The following table indicates a portion of the results obtained.

TABLE I.

No. of the experiment.	Number inches of sand in the tube. — Packed.	Number inches of sand in the tube. — Unpacked.	Weight which it was necessary to place on the platform in order to force the sand from the tube.	REMARKS.
	Inches.	Inches.	Pounds.	
36		2	310	
37	2		350	
38		3	260	
39	3		360	
40	3		760	
41		4	2166	
42	4		2540	
43	4			Experiment lost.
44	4		2150	
45	5			With 2100 lbs. the piston was not moved.
46	9			With 1900 lbs. the piston was not moved.

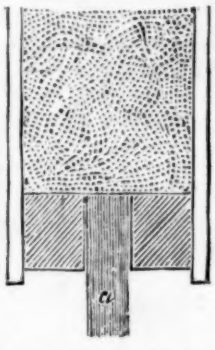
Observations on Table I.—The tube was of the kind called double tin, 15 inches long, and $1\frac{1}{4}$ inches in diameter, folded at the seam, and strongly soldered. The piston was just inserted into the bottom of the tube, and the weights given in the fourth column, were those which were necessary to force it quite through the tube, with the sand before it. In the experiment No. 46, where 9 inches of packed sand were tried, after a weight of 1900 pounds had been placed on the platform, without producing any effect, an effort was made to drive the sand from the tube by forcing up the sliding board, *e*, with a lever. In this operation the tube was bent, and split at the soldering, but the sand was not forced out. It was soon ascertained that very great weights would have to be used when the depth of the sand was equal to, or greater than four times the diameter of the tube, and that the process would be tedious; it was accordingly resolved to abandon the use of dead weights, and employ the momentum of falling bodies. Previously to making these trials, a glass tube $\frac{3}{4}$ths of an inch in diameter, was procured and experimented upon. It admitted six inches of sand to be forced out of it, but with 8 inches of sand well packed, it burst when the dead weight of 550 pounds was applied.

TABLE II.

No. of the experiment.	No. of inches of sand in the tube. Packed.	Weight with which the platform was loaded.	Distance through which the platform fell with the foregoing weight.		Distance through which the piston was forced by the foregoing power.	REMARKS.
	inches.	pounds.	feet.	inches.		
47	5	920		10	none.	In these experiments the rope stretched so as to permit the platform to touch the floor before producing the full effect.
48	"	1120	2	0	do.	
49	"	1320	2	"	do.	
50	"	1320	3	"	thro' the tube	
51	6	1320	3	"	none.	Trial defective.
52	"	1630	3	"	none.	The rope was broken, trial defective.
53	"	1630	3	5	thro' the tube	
54	7	1630	3	0	none.	The tube was split.
55	"	1630	3	"	$\frac{1}{4}$ of an inch.	
56	"	2030	3	"	$\frac{1}{2}$ of an inch.	The apparatus was broken, and the tube split.
57	"	1630	3	5	none.	Apparatus broken.
58	"	1630	3	4	$\frac{1}{8}$ of an inch	
59	"	1930	2	6	$\frac{1}{4}$ of an inch.	
60	"	2030	3	0	$\frac{1}{8}$ of an inch.	Broke one of the beams supporting the pullies, *f*, *f*, and parted a $3\frac{1}{2}$ inch bolt rope.
61	"	2030	3	4	$\frac{1}{4}$ of an inch.	The rope was broken and the tube split at the soldering.
62	"	2030	4	0		Split the tube and forced out the sand in consequence.
63	"	2030	4	0	$\frac{1}{2}$ of an inch.	Parted a $3\frac{7}{8}$ inch white hemp rope.

Observations on Table II.—The tube and rope were the same as described in observations on table I. The experiment No. 61, the top of the sand was made even with the top of the tube before the experiment was begun, by pushing up the piston until only so much space was left above it, as it was intended the sand should occupy. This rule was observed in all the subsequent experiments. This table shows that it required a weight of 1320 pounds, falling 3 feet, to force 5 inches of dry sand out of a tube $1\frac{1}{4}$ inches in diameter, and 1630 pounds, falling 3 feet 5 inches, to force out 6 inches of sand. Experiments, 60, 61, 62, and 63, showed that the apparatus in its then state could not sustain the force necessary to expel 7 inches of sand, and accordingly these experiments were suspended until a cast brass tube could be procured, and an iron chain be fitted instead of the rope. Other measures were also adopted for strengthening the apparatus.—While these arrangements were making, a series of experiments were tried with a conical plug above the piston, as in the annexed sketch. The height of the cone was three inches, and its base equal to the area of the top of the piston. The details of these experiments it is deemed unnecessary to give. Their general result was, that within the limits tried, greater resistances were obtained when the cone was used than when it was omitted.

Observations on Table III. The tube was of bras, cast about one-fourth of an inch thick, the interior diameter being one and one-fourth inches as far as experiment No. 111, after which it was increased to one and seven-sixteenth inches. A chain, capable of supporting nine tons, was substituted for the rope, *h*, *h*, *h*., and after experiment No. 90, a strong chain was employed in lieu of the rope, *k*, *k*. The apparatus was strengthened in a variety of ways to enable it to resist the great shocks it was subjected to. It appears from this table, that to expel seven inches of dry packed sand from a tube one and one-fourth inches in diameter, it was necessary to employ a weight of 2286 pounds falling through a space of three feet eleven inches. A weight of 2644 pounds falling three feet, was insufficient to force from the same tube eight inches of sand. Sand poured loosely into the tube, without being packed, offered much less resistance. Seven inches of loose sand was expelled by a weight of 361 pounds falling three feet eight inches; nine inches by a weight of 615 pounds, falling three feet nine inches; and ten inches by a weight of 870 pounds falling three feet ten inches. Eleven inches in a tube of one and seven-sixteenth inches bore, was expelled by 1630 pounds, falling three feet ten inches; twelve inches, by 2136 pounds, falling three feet six inches; and 2136 pounds, falling three feet nine inches, did not drive out thirteen inches of loose sand. The strength of the apparatus did not admit of carrying these trials further in this



way, and it was resolved to use gun powder; but in the meantime to determine the resistance which would be offered by the sand to the entrance of iron rods of much less diameter than the bore of the tube, the following experiments were made. Rods of one-fourth, one-half, and three-fourths of an inch diameter were used. The tube being one and seven-sixteenths inches in diameter, a wooden piston having a hole in its centre, just large enough to admit the rod *a*, in the manner indicated by the annexed sketch, was placed in it, and the rod being entered into the piston, the sand was placed above it as usual. With this apparatus, the experiments contained in table IV., were, among others, tried.

Observations on Table IV. The resistance opposed by the sand to the entrance of a rod of smaller diameter than the tube, was very great, and increased with the size of the rod. A weight of 2033 pounds was required to force a $\frac{1}{4}$ inch rod through 8 inches of sand. With 12 inches of sand, a weight of 3150 pounds was required to force the same rod, sharpened, $2\frac{1}{2}$ inches into the tube. Sharpening the $\frac{1}{4}$ inch rod, seemed rather to increase than to diminish the resistance. A half inch rod was forced through 8 inches of sand, by 870 pounds falling 4 feet. With 13 inches of sand, a $\frac{1}{2}$ inch rod was forced only $1\frac{3}{4}$ inches, by a weight of 1880 ponnds falling 3 feet 4 inches. A rod $\frac{3}{4}$ of an inch in diameter, was forced through 8 inches of sand by 1120 pounds, falling 3 feet 10 inches; and the same rod was forced through 13 inches of sand by 2136 pounds, falling 3 feet 3 inches. In all cases the sand immediately before and around the rods, was crushed to a fine powder.

TABLE III.

No of the experiment	No of inches of sand in the tube Packed	No of inches in sand in the tube Unpacked	Weight with which the platform was loaded	Space through which the loaded platform was allowed to fall		Distance through which the piston was forced by the foregoing power	REMARKS.
	in	in	lbs	feet	in		
87	7		1375	3	10	$\frac{1}{8}$ of an inch	
88	7		1670	3	11	$\frac{1}{4}$ of an inch	Broke a beam over head; and on taking up the floor for the purpose of putting up new props, it was found that three of the floor joists were ruined by the severity of the previous shocks. An iron axletree, $1\frac{1}{8}$ inches in diameter, of one of the pillars, f, over head, was broken off.
89	7		1880	3	10	$\frac{1}{4}$ of an inch	Broke the axle of one of the pulleys over head. The beams supporting these pulleys were brought nearer together, and iron trunnion plates were placed under each axle to prevent its being forced into the wood.
90	7		2030	3		$\frac{1}{4}$ of an inch	Broke the rope k, k, connecting the chain with the sliding board e, under the piston. A chain was substituted in the place of this rope, and the apparatus thus made to conform in all respects, with the description which has been given of it.
91	7		2030	3	6	$\frac{1}{2}$ of an inch	
92	7		2286	3	11	Piston forced thro' the tube.	In this and all other cases where the piston was forced through the tube, a quantity of fine dust, apparently arising from the pulverization of a part of the sand, collected on the sides of the tube and at the top of the piston.
93	8		2286	3	9	$\frac{1}{4}$ of an inch	
94	"		2490	3		$\frac{1}{4}$ of an inch	Broke a large iron hook at the tube end of the large chain.
95	"		2490	3		1-16 "	Broke the large chain in four pieces.
96	"		2490	3	9	$\frac{1}{4}$ of an inch	
97	"		2644	3		$\frac{1}{3}$ of an inch	Broke one of the hooks connecting the chain k, k, with the sliding piece, e.
98	"		2644	3		none	Broke the large chain. The apparatus could not, without considerable trouble and expense, be made to sustain the force necessary to expel 8 inches of packed sand, and the further pursuit of this inquiry was therefore abandoned.
104		7	361	3	8	Piston forced thro'	
105		8	361	3	3	$2\frac{5}{8}$ inches.	
106		9	615	3	10	Pn. forced through	
107		10	615	3	9	none	
108		10	870	3	10	Pn. forced through.	
109		11	870	3	8	$\frac{5}{8}$ of an inch	
110		11	1122	3	3	1 inch.	
111		11	1375	3	4	2 inches.	The interior diameter of the tube was now increased to 1 7-16 in inches, with which all the remaining experiments were made.
113		11	1630	3	10	Pn. forced through.	
115		12	1880	3	3	$\frac{1}{8}$ of an in.	Broke the chain.
118		12	2136	2	3	$\frac{1}{5}$ of an in.	Broke the chain.
120		12	2136	3	3	$\frac{1}{2}$ of an in.	Broke the chain. This chain being much strained and worn by previous shocks a new one was procured.
121		12	2136	3		$\frac{3}{4}$ of an inch	Broke the chain.
122		12	2136	3		Pn. forced through	
124		13	2126	3	9	$1\frac{3}{4}$ inches.	

TABLE IV.

No of the experiment.	No of inches of sand. Packed.	Dead weight applied.	Falling weight.	Distance through which the loaded platform was allowed to fall.		Distance which the iron rod was forced into the sand, by the foregoing power.	REMARKS.
	in.	lbs.	lbs.	feet.	in.	inches.	
Iron rod $\frac{1}{4}$ of an inch in diameter.							
133	8	615				$\frac{1}{4}$ of an inch.	
134	"	1150				1 inch	
135	"	1630				$1\frac{1}{2}$ "	
136	"	2033				through the sand	
137	12	615				3-16 of an inch	
138	"	1150				$\frac{1}{2}$ "	
139	"	1630				1 inch	
140	"	2136				$1\frac{1}{2}$ inches	
141	"	2480				?	Rod bent and broken.
142	"	615				3-16 of an inch	In these trials the end of the rod was sharpened.
144	"	1630				7-8ths "	
146	"	2390				$1\frac{3}{4}$ inches	
148	"	3000				$2\frac{1}{4}$ "	
149	"	3150				$2\frac{1}{2}$ "	
150	8		360	3	4	2 "	
151	"		615	3	4	through the sand	
Rod $\frac{1}{2}$ an inch in diameter.							
152	8		360	3	6	$1\frac{1}{2}$ inches	
153	"		490	4		$1\frac{3}{4}$ inches	
154	"		615	4		$1\frac{3}{4}$ inches	In this, and every other instance, a mass of finely pulverized sand was found at the head of the rod.
155	"		870	4		through the sand	The sand around the rod was pulverised to a fine powder.
157	13		1120	3	3	1 7-8th inches	The rod was bent below the tube.
158	"		1375	3	3	$\frac{1}{2}$ an inch	
159	"		1880	3	6	$1\frac{3}{4}$ inches	Bent the rod double in two places below the tube.
Rod $\frac{3}{4}$ of an inch in diameter.							
160	8		870	3	10	$\frac{3}{4}$ of an inch	
161	"		1120	3	10	through the tube	The sand around the rod crushed to a fine powder.
162	13		1120	3	9	7-8th of an inch	The pulverized sand at the head of the rod as usual.
163	"		1375	3	6	1 inch	The chain was broken.
164	"		1880	3	6	$1\frac{1}{4}$ inches	
165	"		2136	3	3	thro' the sand	

TRIALS WITH GUN POWDER.

166. A musket barrel, of three-fourths of an inch bore, was charged with two inches of powder and thirteen inches of packed sand, there being neither wad nor plug between the sand and the powder. On firing, the barrel was burst, but the sand was not driven out.

167 & 168. A brass blunderbuss barrel of three-fourths of an inch bore, was charged with one inch of powder, and ten inches of packed sand, a wooden plug being placed

between the powder and sand. On firing, the plug was split, and all the sand driven out, but the pieces of the plug remained in the barrel, which was apparently uninjured. The same barrel burst with one inch of powder, and ten inches of packed sand, with a conical wooden plug between the sand and the powder.

169. A pistol barrel of nine-sixteenths of an inch bore, burst with one inch of powder and eight inches of packed sand, without wad or plug.

170. An old musket barrel of three-fourths of an inch bore, was loaded with three-fourths of an inch of powder, and five inches of packed sand, without wad or plug.—On firing, the barrel was burst, but the sand was not driven out.

172. A piece of musket barrel, taken from near the muzzle, and open at both ends, was charged at one end, with five and a half inches of brick dust, hard rammed; and at the other with five and a half inches of sand, well packed, with one inch of powder between them, a priming hole being bored to communicate the fire. The explosion of the powder burst the barrel, but neither the sand nor the brick dust was driven out.

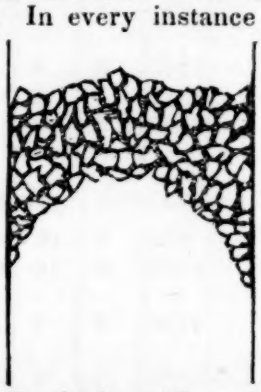
177 to 184. A pistol barrel made of twisted iron, and of great strength, the bore being eleven-sixteenths of an inch, was fired with three-fourths of an inch of powder, and the following loads of sand, each one, with and without a wad, viz: three inches, four inches, five inches, and six inches. In all these trials the sand was driven out without causing the barrel to burst.

185. The same pistol barrel was loaded with one inch of powder, and eight and one-fourth inches of sand, with a conical plug between the sand and the powder. On firing, the sand was forced out.

186. The same barrel was charged with one inch of powder, and eight and one-fourth inches of sand, without wad or plug. On firing, the sand was driven out, and the barrel was burst.

In order, if possible, to determine a limit to the resistance opposed by sand, it was resolved to make use of a twenty-four pound cannon. It was thought not improbable, that by the use of clean dry sand, which is generally obtained in the vicinity of the sea coast batteries, a ready method would be discovered of effectually destroying heavy guns, an object which is occasionally of great importance. Application was therefore made to the ordnance department for permission to experiment with an old pattern twenty-four pounder, laying at Fort Adams, which permission was very liberally and readily granted. The length of the bore of this piece was about nine feet, and the diameter of the bore $5\frac{82}{100}$ inches It was first fired in a horizontal position with eight pounds of powder, and one foot of sand, afterwards with the same quantity of powder, and two feet of sand, again with the same quantity of powder, and three feet of sand, and so on, the depth of the sand constantly increasing by one foot, until the bore was full. The gun was then placed in a vertical position, and loaded with the same quantity of powder, and filled up to the muzzle with sand, well packed, without wad or plug. It was afterwards charged in a similar manner, a cone of wood being interposed between the powder and the sand. In these two cases the fire was communicated to the charge by means of a priming tube, passing down through the sand from the muzzle of the gun. Afterwards the gun was charged in the same manner, and fired by means of the vent. A better quality of powder was then used, and the quantity was increased to sixteen pounds. The gun was several times fired with this charge, the bore being filled up to the muzzle with sand well packed.—In every instance the sand was forced out without apparent injury to the gun. It appeared, therefore, that the resistance of the sand, though very great, was not sufficient to burst a twenty-four pound cannon.

The most probable explanation of the foregoing phenomena, appears to be, that whenever direct pressure is applied, the angular and irregular shaped fragments composing the sand, immediately form themselves into a natural arch, supported against the sides of the tube. The annexed sketch indicates the manner in which this may take place. In every instance where the



sand was violently forced from the tube, the sides of it were found to be lined with a quantity of fine dust, and a mass of pulverized sand was generally found at the head of the piston A. The inside of the tube was abraded or scratched, particularly at that part, a short distance above the piston, against which the *arch*, or more strictly the *inverted dome* of sand, may be supposed to have abutted. The dust found on the sides

of the tube was always of a blueish color, which was attributed to the intermixture of a small portion of metallic oxide derived from the brass. Some experiments which were made went to show that it was very important that the sand should be perfectly dry. The injurious effect of moisture may be explained by supposing that it impedes the free motion of the particles among themselves, and prevents their promptly assuming the arch form; it cements the sand into a mass, which is expelled from the tube as a solid body would be. In the case of the twenty-four pounder, it appears that the force necessary to burst the gun, was greater than that required to reduce sand to an impalpable powder, that is, to crush and destroy the materials of which the arch of sand was composed. It is probable that coarse emery, from its extreme hardness, would oppose a resistance sufficient to burst a cannon, but an opportunity has not offered to make the trial.

The experience of Fort Adams, proves that the resistance offered by sand is quite aufficient for blasting rocks, and the advantages attending it use, are, that it is much less troublesome than the usual mode, and that it is perfectly safe. To ensure success, the space left above the powder should have a length of ten or twelve times as great as the diameter of the hole. To communicate fire to the powder, a slip of paper is rolled into a tube about three-sixteenths of an inch in diameter. This priming tube is secured by being tied round in two places with thread, and one end is made a little larger than the other, so that any required length may be obtained by joining several together. The charge of powder being in its place, the priming tube is inserted and filled, it is then pressed against one side of the hole, and the sand is slowly poured in. A slender stick of hard-wood is rapidly worked up and down in the sand as it falls to the bottom, and thus every part becomes well packed. By this mode of operating there is, of course, no danger of communicating fire to the powder in the act of loading, an accident very liable to happen in blasting in the common way. The safest and most convenient method of firing the blast, is by means of a small slip of paper which has been dipped in a solution of saltpetre, and dried.

It was intended to make examinations on other points connected with the phenomena observed by M. Burnand, but the requisite leisure has not been at command. The subject merits further investigation with a view to making useful practical applications of some of the remarkable properties which sand is found to possess.

OBSERVATIONS ON THE FREQUENT PRESENCE OF LEAD IN ENGLISH CHEMICAL PREPARATIONS; ON THE CAUSE OF THAT PRESENCE; AND OTHER REMARKS RELATIVE THERETO. BY GUSTAVUS SCHWEITZER.—The examination of the purity to chemical preparations, in which I have been engaged for some time, convinces me tha many of them are impure and contain lead, In several which I have examined I have found subcarbonate of magnesia containing lead in the proportion of 2.40 grains subcarbonate of lead in 1000 grains of subcarbonate of magnesia. Bicarbonate of potash contained a similar proportion; bicarbonate of soda, subcarbonate of ammonia, &c., showed the same impurity. It is clear, when these substances, so universally used, contain lead, that many other combinations which are prepared from them must be equally impure. The cause of this impurity arises greatly from the manner in which these substances are prepared. Leaden vessels are too often used for the crystallization and precipitation of them, and how easily alkaline substances act on lead is too well known to need comment. But another cause of this impurity, although the portion present is but very small, is the white glass used in this country, which must be an object of great consequence to practical chemists and druggists. I know not whether any direct experiments have been made to show what influence alkalies, acids, and salts may have on white glass. I have therefore endeavored to ascertain this point by the following experiments:—White glass bottles, such as are used for medicine, were taken and filled, some with distilled water and others with common water. No lead was imparted to the water in either case, even after immersion in it for a few weeks exposed to a common temperature; but when the distilled water was impregnated with carbonic acid gas, after a few days the fluid gave, with the proper tests, ample proof of the existence of lead, and when boiled to expel the gas, no indication of lead was obtained, proving that a bicarbonate of lead was formed by the action of the carbonic acid gas on the glass. Acetic acid, nitric acid, muriatic acid also take up lead from white glass. Diluted sulphuric acid, after standing some time in these glasses, shows no indication of dissolved

lead; but after pouring off the acid and rincing the bottle with nitric acid, the presence of lead was detected. Neutral salts showed an equal action, when they contained such acids as produce with oxide of lead insoluble combinations, or combinations of very sparing solubility, and produced more or less a film on the glass, which film was dissolved by nitric acid; as the phosphates, oxalate, chromates, sulphates. Chloride of lead is but slightly soluble in pure water, and, according to my analysis, 100 parts of distilled water will dissolve 0.74 part of chloride of lead. Solutions of chlorides will also dissolve chloride of lead, more or less, according to their strength, but still less than distilled water, because when to a concentrated solution of chloride of lead in distilled water a few drops of chloride of calcium 0.2 strength are added, the greater part of the chloride of lead will be separated, but by chloride of calcium in excess, the chloride of lead will be retaken up. (*Bischof, Neues Jahresb. d. Chemie und Physick.*) This I found to occur with the chlorides of ammonium, iron, lithium, magnesium, potassium, sodium and zinc, and most likely will be proved to be the case with all chlorides of a corresponding strength. Therefore chloride of lead will be imparted to a solution of a chloride, when kept in white glass bottles according to the strength of the solution of the chloride; the more chloride the solution may contain the less will be taken up of the chloride of lead. The chlorides will take up by boiling a considerable quantity of chloride of lead, a portion of which will chrystalize when the fluid is cooled down.

Caustic alkalies act very powerfully on white glass, and much oxide of lead will be dissolved. Caustic ammonia acts very slightly on the glass; subcarbonate of potash, soda, and ammonia also take up lead, but considerably less than the caustic alkalies. A strong solution of the subcarbonates will take up less than a diluted one. Volatile oils show no action on the glass. These experiments prove that the white glass bottles commonly used are not fit for chemical and medical purposes; which fact is worthy of the attention of the medical board. The addition of oxide of lead in the manufacture of glass to make it more fusible must be avoided. According to the analysis of Faraday, the ordinary flint glass contains 33.28 per cent, of oxide of lead, whereas for all chemical or medical purposes a glass free from lead should be used.*

A piece of lead perfectly clean and bright on the surface was kept in distilled water in a closed vessel, and after some time showed a white crystalline coating of subcarbonate of lead; the fluid was also filled with little crystalline scales. The fluid turned red litmus-paper blue, and tests indicated freely the pressence of lead in the fluid; but when it was carefully filtered through paper which had been freed by weak nitric acid from its impurity, no indication of lead whatever was perccived, showing that the carbonate of lead was merely dispersed in the water and not dissolved. A similar effect was shown by oxide of lead treated with pure water, but no solution of it was perceptible if it was kept with the water, whether in an open or in a closed vessel;—a fact which is opposed to the received opinions. Well-water and mineral water corrode lead, forming a coating of oxide of lead on the mental without taking up a partical of the oxide; but mineral waters strongly impregnated with carbonic acid gas I found to contain faint traces of lead, when they had been for some time in contact with it. Mr. Walker according to his analysis found in the mineral water of Bath, lead originating from the pipes or pump used for the conveying of the water. (Quarterly Journal of Science, Literature, and Art, January to March, 1829.) Might not the lead in these instances be dispersed mechanically in the water?—The result of my experiments induces me to believe so.

Volatile oil dissolves lead freely. Alcohol and æther, when pure, do not act on that metal. When an alkaline fluid contains a trace of lead, the best test to apply is the hydrosulphuret of ammonia, as this reagent will detect $\frac{1}{300,000}$gr. of crystallized

* The results of Mr. Faraday's analysis of various kinds of glass, and some remarks upon the true nature of that substance in general (which are confirmed by Mr. Schweitzer's observations above) will be found in some notes extracted from Mr. Brayley's edition of Parkes's Chemical Chatechism, in the Repertory, new series, vol. i., p. 182, in the number for March, 1834. See also Professor Turner's experiments on glass, vol. ii., p. 298, in the number for November, 1834.—A. T.

acetate of lead; but this is almost the limit of its dilution, as the observation must be made by the light falling upon the surface of the liquid, which must have a diameter of not much less than one inch, In a neutral fluid, or in one which is only slightly acid, the presence of lead may be shown by the application of sulphuretted hydrogen gas; but it is advisable to avoid the use of nitric acid, as by a little surplus of it, faint traces of lead will be easily overlooked. Acetic acid is preferable, because its surplus does not affect the delicacy of the hydrosulphuretted gas. Very good tests also are soluble sulphates and chromates, particularly to decide on the nature of the metal, although not to such an extent as the tests before mentioned. Chromate of potash will indicate traces of lead, when sulphate of soda ceases to do so. Sulphate of lead will be partly dissolved by concentrated nitric acid; muriatic acid shows traces of lead, acetic acid only faintly shows them. Chromate of lead when treated with strong sulphuric acid will be changed into sulphate of lead and the decanted acid will contain no lead. Nitric acid dissolves traces of lead from the chromate; muriatic acid changes the chromate of lead into chloride of lead, and the chromic acid into oxide of chrome, by developing chlorine, particularly by the application of heat. Acetic acid acted on chromate of lead and took up some lead, particularly when the acid was for several days in contact with it: according to Mans (Poggendorff's *Annalen*, band ix. p. 127), it is not soluble in acetic acid.—*Lond. and Edinb. Phil. Mag.*, vol. viii., p. 267, et seq.

MAGNETIC EXPERIMENTS ON AN IRON STEAM-VESSEL. BY COMMANDER E. J. JOHNSON, R. N.—The following is an abstract, from the proceedings of the Royal Society, of a paper read before that learned body, on March 10, 1836 :—

Report of Magnetic Experiments tried on board an Iron Steam-vessel, by order of the Right Honorable the Lord Commissioners of the Admiralty. By EDWARD J. JOHNSON, Esq., Commander R. N., accompanied by Plans of the Vessel, and Tables showing the horizontal deflection of the Magnetic Needle at different positions on board, together with the dip and magnetic intensity observed at those positions, and compared with that obtained on shore with the same instruments. Communicated by Captain Beaufort, R.N., F.R.S., Hydrographer to the Admiralty; by command of the Right Honorable the Lords Commissioners of the Admiralty.

This report commences with a description of the iron steam-vessel, the "Garryowen," belonging to the Dublin Steam Packet Company, and built by the Messrs. Laird, of Liverpool. She is constructed of malleable iron, is 281 tons burthen, and draws only five and a quarter feet of water, although the weight of iron in the machinery, &c. is 180 tons.

This vessel was placed under the directions of the author, in Tarbert Bay, on the Shannon, on the 19th of October, 1835, for the purpose of investigating its local attractions on the compass. The methods which were adopted with that view are given; together with tables of the results of the several experiments, and plans of the various parts of the Garryowen. The horizontal deflections of the magnetic needle at different situations in the vessel were observed, for the purpose of ascertaining the most advantageous place for a steering compass, and also for the application of Professor Barlow's correcting plate; and the dip and intensity in these situations were, at the same time, noted.

An experiment is detailed, showing that where several magnetic needles, freely suspended, were placed upon the quay, in Tarbert Bay, and the vessel warped from the anchorage towards them, first with her head in that direction and then with her stern, opposite deflections were produced: in the first case all the needles showing a deviation to the eastward, and in the latter to the westward, of the true magnetic meridian.

Considering the height of the general mass of iron in the vessel and also that of the head and stern, together with the distance (169 feet) at which some of the needles indicated a deviation, the author concludes that the respective deflections were caused by the magnetic influence of the iron in the vessel; the combined effect of that about the bows representing the north pole of a magnet, and that about the stern a south pole. He then offers several suggestions for future observation on this sub-

ject, and connected with the little oxidation that is reported to have taken place in the vessel.

The experiments having been interrupted by a continuance of wet and stormy weather, the author proceeds to draw the following general practical conclusions, deduced from the series of observations already made, and points out the further experiments which he considers necessary to be tried.

1st. The ordinary place for a steering-campass on board ship is not a proper position for it in an iron steam-vessel.

2d. The binnacle-compass in its usual place on board the Garryowen is too much in error to be depended upon.

3d. In selecting a proper position for a steering-compass on board iron steam-vessels, attention should be paid to its being placed, as far as is practicable, not only above the general mass of iron, but also above any smaller portions of iron that may be in its vicinity, or such portions of iron should be removed altogether.

4th. The steering-compass should never be placed on a level with the ends either of horizontal or of perpendicular bars of iron.

5th. The extreme ends of an iron vessel are unfavorable positions, in consequence of magnetic influences exerted in those situations. The centre of the vessel is also very objectionable, owing to the connecting-rods, shafts, and other parts of the machinery belonging to the steam-engine and wheels, which are in continual motion; independently of the influence exerted by the great tunnel in this part of the ship.

6th. No favorable results were obtained by placing the compass either below the deck, or on a stage over the stern.

7th. It was found that at a position 20½ feet above the quarter-deck, and at another 13¼ feet above the same level, and about one-seventh the length of the vessel from the stern, the deflections of the horizontal needle were less than those which have been observed in some of his Majesty's ships.

The author proceeds to point out various methods of determining, by means of a more extended inquiry, whether the position above indicated, or one nearer to the deck, is that at which the steering-compass would be most advantageously placed.

The concluding section contains an account of some observations made by the author on the effects of local attraction on board different steam-boats, from which it appears that the influence of this cause of deviation is more considerable than has been generally imagined; and he points out several precautions which should be obrerved in placing compasses on board such vessels.

We have seen, this week, at Leeds, a specimen of bleached flax, prepared by a York chemist, which appears to present a decided improvement in the manufacture of that article. It has created a great sensation amongst the manufacturers, and been taken for silk. It is capable of being manufactured into the finest thread for veils, lace, cambric, etc., and will supersede those articles of French manufacture. The texture is most beautiful. [Doncaster Chronicle.]

METEOROLOGICAL RECORD

For the month of June, 1836, kept at Avoylle Ferry, Red River, La., (Lat. 31° 10′ N. Long. 91° 59′ W.) by P. G. VOORHIES.

JUNE.

Days.	Morn.	Noon.	Night.	Wind.	Weather.	REMARKS.
1	72	82	74	calm	clear	
2	67	82	76	w	..	
3	68	82	77	sw	..	
4	65	77	74	calm	cloudy	at noon clear
5	62	78	76	..	..	
6	71	88	82	sw	clear	
7	71	89	84	s	..	
8	70	89	86	calm	cloudy	
9	71	90	86	..	..	
10	84	89	87	sw	clear	
11	74	89	84	calm	..	Red River falling
12	72	86	78	NE	..	
13	68	86	73	E	..	
14	70	86	73	calm	..	
15	68	85	76	..	..	
16	69	88	77	sw	cloudy	showers in the morning from sw
17	71	88	76	calm	..	distant thunder
18	74	86	74	sw	..	showers in the evening, heavy rain at night
19	71	84	76	SE	..	heavy rain at night
20	68	85	76	sw	clear	
21	69	89	76	..	..	
22	74	88	84	calm	cloudy	heavy thunder in the afternoon
23	76	74	75	sw	..	thunder and rain at noon and all night
24	76	86	78	calm	clear	
25	74	86	78	sw	..	
26	76	86	84	..	..	
27	75	87	83	calm	..	
28	76	88	83	..	..	
29	76	86	74	..	cloudy	showers, rain at noon
30	72	86	82	..	clear	